Photo-Aquatint and Photogravure

HUSON ON

PHOTO-AQUATINT

AND PHOTOGRAVURE

"THE ROAD TO NORTH BOVEY," A PHOTO-AQUATINT BY THE AUTHOR, FROM HIS OWN WATER-COLOR PAINTING.

HUUSON ON

PHOTO-AQUATINT & PHOTOGRAVURE

A PRACTICAL TREATISE

WITH ILLUSTRATIONS AND A PHOTO-AQUATINT PLATE

BY

THOS. HUSON, R.I., R.E.

To which is appended

A TREATISE

ON

Machine Printed Photogravure

Chiefly Compiled from a number of Original Articles Contributed to *The Process Photogram* during 1896–7

BY

A. VILLAIN AND J. WILLIAM SMITH

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PREFACE.

THE Author feels that no apology is needed in introducing this work to the public. He has a lively recollection of the many troubles which beset his path at the time when he first determined to make himself master of the processes dealt with in the following pages; for at that period, though the general principles on which Photogravure was founded were known, it was practically a secret process. Such details as were published were not only meagre, but, as the author found, in many cases quite unreliable and misleading.

In the present work no process is described and recommended (many, indeed, are of the Author's own devising) which has not been well tried and approved of by himself.

THOS. HUSON.

NORTHCOTE, WATERLOO,
NEAR LIVERPOOL,
June 1897.

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BOOK II.

MACHINE-PRINTED PHOTOGRAVURE.

PHOTO-AQUATINT.

A few weeks ago an excellent little book dealing with the bichromate-gum process of pigment-printing was issued from the office of *The Amateur Photographer*. The book was written by Messrs Alfred Maskell and R. Demachy, and took as its first title *Photo-aquatint*. In spite of this it has been decided to issue the present little book under the title first planned for it; and to use for the process of Photo-engraving here described the name coined for it at the time of its first announcement, by Mr Huson, and used by him consistently and publicly ever since. Hence, in the interests of historical accuracy, and to save ourselves from a charge of plagiarism, it seems well to print the following extracts from *The Amateur Photographer* of May 28th, 1897. The letters first quoted were in answer to an editorial note which implied that Mr Huson's use of the term photo-aquatint, in a paper read before the Royal Photographic Society, was his first use of the term, and was subsequent to Mr Maskell's application thereof to a totally different process. As a matter of fact, Mr Huson's right of priority is of some years' standing (the claim quoted below was made long before the publication of Mr Maskell's book), and there seems no real reason to drop the term and coin another, because it has been subsequently and unfortunately applied to a different process.

FROM *THE AMATEUR PHOTOGRAPHER*,
May 28, 1897.

PHOTO-AQUATINT.

SIR,—Your note on the front page of the current issue raises the question of precedence in the use of the above term. Mr Huson's use of it at the Royal Photographic Society was not by any means his first, for he had an article in the *Process Photogram* for September 1895 (page 107), in which he used as a sub-title, "Notes on Photogravure or Photo-Aquatint." In the following issue, page 133, was a second article with this sub-title used as its main title. We are under the impression that Mr Huson has used the same title for his special method of photogravure in other and earlier publications; and as this is not a second title given to an already well-known process, but a title given to distinguish a greatly modified process worked out by Mr Huson from the photogravure process already known, we think you will see that the title properly belongs to him and to his process, and cannot reasonably be taken by Mr Alfred Maskell to describe the bichromate gum process, or to entitle a book dealing with that process.—Yours faithfully,

THE EDITORS OF THE *Photogram*.

SIR,—My attention has been drawn to a paragraph which appears at page 209 of your issue for 21st inst., in which you state that you are under the impression that the first use of the term photo-aquatint was in your columns of April 23rd. Please note that your impression is a mistaken one.

It is some years since I first adopted this term to indicate the modification of the Talbot-Klic process of photogravure which I practise, and you will find it in various published articles from my pen, as, for instance, in the *Process Photogram* for September 1895, "Cause and Cure of 'Devils,' Notes on Photogravure or Photo-aquatint." And again in the same journal for October 1895, "Notes on Photogravure or Photo-aquatint."—Yours truly, THOS. HUSON.

Commenting also on the paragraph referred to, Mr Alfred Maskell, in the course of a letter on another matter received this week, says:—"'Aquatint' is already known in connection with etching (though, in my opinion, a misleading term), but I use the term 'photo-aquatint' for the gum-bichromate process to express the use of *water colors* employed." It is certainly regrettable, as Mr Huson has the right of priority, that the word photo-aquatint should now have two meanings, though it is probable that whilst the process which Mr Maskell so enthusiastically exploits would be more euphoniously named photo-aquatint, it will be for ever known by the more uncompromising title of "gum-bichromate."

Unless we are mistaken (and, if we are, we shall be glad if Mr Huson will set us right), this gentleman uses the term photo-aquatint to signify a photo-etched result which bears a close resemblance to appearance of aquatint. Mr Maskell would seem to have used the term as descriptive of the means employed rather than the appearance of the finished result, and even in that case we fancy "gum-bichromate" would have been best.—ED. *A. P.*

BOOK I.

PHOTO-AQUATINT AND PHOTOGRAVURE.

CHAPTER I.

Introductory.

In the old-fashioned engraver's process of Aquatint, a polished copperplate was prepared by depositing on its surface a layer of minute grains of some resinous and acid-resisting substance. This was sometimes done from the solution of the resin in spirits of wine, in which case the grain made its appearance on the evaporation of the solvent, attached to the plate, and ready for etching; at others, the resinous particles were deposited in the form of dust, and were attached to the plate by fusion. On the plate thus prepared the artist traced the outlines of his subject, the highest lights

of, which were then painted out, "stopped out" being the technical term, with an acid-resisting varnish. The plate was then immersed in a suitable etching solution long enough to bite all of the unstopped parts of it to the depth of what were to be the palest tints in the finished picture. Stopping out was then again resorted to for the second tints, and so on, until the whole plate was bitten to various depths suitable to a reproduction of the scheme of light and dark of the picture.

In Photo-aquatint the plate undergoes precisely the same preparation, as to its ground, as that just described, but instead of etching in stages by stopping out, the aid of photography is called in, and gradated etching is achieved by attaching to the grounded plate a negative picture in insoluble gelatin, through the various thicknesses of which the etching solution slowly percolates, attacking the copperplate underneath, and biting it in gradation corresponding to the various thicknesses of gelatin through which it has to work its way — the thinnest portions of gelatin covering those parts of the plate which will be the deepest shadows, and the thickest, the high-lights, with various gradations between.

It will be seen from this sketch of the two processes, that there is a strong resemblance between them in many ways, and, to my mind, Photo-aquatint would have been a more descriptive title to apply to this kind of photo-engraving, than Photo-

gravure. As, however, the latter term has become well established, I have for some years used the term photo-aquatint to describe the particular modification of photogravure which I practise, and which it is my purpose to describe, together with an outline of the usual photogravure process, in the following pages.

CHAPTER II.

Brief General Description of Photo-aquatint and Photogravure.

A COPPER PLATE, polished on its face, is taken. On this a ground of resinous particles is laid, now, almost exclusively, by the deposition of dust by means of a suitably constructed box. The dust particles are then fused by heating the plate. On the prepared plate a picture is developed by the carbon process. This carbon picture is known as the "resist." The back and edges of the plate are then protected by acid-resisting varnish. The plate is now etched through the substance of the carbon picture by means of a solution of perchloride of iron, and, the etching being completed, the carbon resist is removed, also the dust ground, and the plate is ready for printing in the rolling-press, by copper-plate printers' methods.

CHAPTER III.

The Negative and Transparency.

The first essential for the production of a satisfactory plate is a first-rate negative. It will be sufficient to say that it must be of the best kind, one which will give a satisfactory transparency by whatever process the worker decides that this is to be made. Any attempts to use hard, under-exposed negatives wanting in gradation, will surely end in waste of material, failure, and disappointment.

The Transparency.—This must be reversed. The usual plan, in working from an unreversed negative, is to make the transparency by means of the carbon process. The Autotype Company's "Special Transparency" tissue is convenient for the purpose. If a carbon transparency is to be used, it must in all cases be strongly intensified, which can easily be done by immersing it in a solution of permanganate

of potash. This quickly alters the colour of the picture to a very non-actinic brown. The difficulty with transparencies of this kind, is to correctly estimate their strength, as, owing to the very non-actinic quality of the color, what may appear to be a somewhat thin transparency may turn out to be too dense to give satisfactory results.

I much prefer, whenever possible, to work from a reversed negative, and to use plates coated with emulsion of the lantern-slide type for the transparency. Either the gelatin or collodion varieties of emulsion are good, and no pains should be spared to get the transparency as perfect as possible, as, if this be done, the subsequent parts of the process are comparatively plain sailing, whereas any deficiency in the transparency means work of a more or less difficult kind on the copper plate at a later stage of the process. The kind of transparency to aim for is one which, when held at a suitable angle to a sheet of white paper strongly illuminated by reflected light, looks quite satisfactory in its gradations and strength of light and shade. A brilliant transparency of the lantern-slide type will be sure to give good results by this process.

If the transparency should be uneven in gradation or its strongest darks wanting in depth, much can be done by the judicious use of the retoucher's pencil, or, in the case of those who have the requisite artistic skill, by careful painting up with

varnish colours of tone to match that of the transparency; working either on front, or back, or both, as may seem needful. I have sometimes, in landscape subjects, put in with good effect whole skies in this way.

The colors I have found most convenient to use are blue-black, French blue, rose madder, and caledonian brown or burnt sienna. These are ordinary oil-paints, and should be thinned with copal varnish, or some strong-drying medium, and, of course, the painted transparency must be allowed to dry very thoroughly before attempting to use it for printing from.

The glass on which the transparency is printed should have a margin of about $\frac{1}{4}$ inch all round to allow of a suitable "safe edge" being attached without encroaching on the picture. For safe edge I find the gummed strips of black paper sold as lantern-slide binders, convenient.

The limits of the picture should be marked on the face of the transparency, and a strip of paper carefully gummed down (also on the face of the transparency) each side of the picture. I am aware that it is usually advised to do this on the back of the plate to avoid the risk of frilling, or lifting of the film when the resist is being developed; but (I speak from extensive experience) I have never had the least trouble on this score, and it is easier to adjust the paper strips on the face than on the back of the plate.

The strips being attached, mark them in pencil at each of the four corners, thus :—

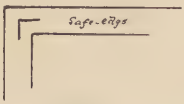

Fig. 1.

These pencil-marks will be the guide to the adjustment of the carbon tissue which is to form the resist.

CHAPTER IV.

Sensitising and Drying the Tissue. Printing. The Resist.

For the resist, the Autotype Company's "Special Autogravure" tissue, will be found well adapted. There are several varieties, all equally good. The choice of which to use is a matter of individual taste. I prefer the "Red" variety.

The usual plan of sensitising and drying the tissue is clearly described by the Autotype Company in their instructions. My own method is as follows:—

Dissolve bichromate of potash in the proportion of 1 oz. to 1 pint of water, add 5 drops of liquor ammonia to each pint of solution, and filter. This is the sensitising solution.

Use a deep pattern dish for this, and enough solution to fill it to the depth of not less than an inch. Immerse the tissue, and carefully remove

air-bubbles from both front and back by means of a soft camel-hair brush. Allow the tissue to remain in the bath for three minutes, then remove it, and place it face downwards on a clean sheet of ferrotype plate. Remove the surplus solution from it by passing a squeegee several times over it, and put it aside to dry.

The drying-box which I use, and which I find most convenient, is one large enough inside for each side to hold a full-sized ferrotype plate. It measures internally, 12 inches deep $\times 15 \times 15$. The lid is light-tight. The bottom of the box is occupied by a strong tinned-iron tray, about 2 inches deep: an ordinary dripping-pan is as good as anything else, containing asbestos, well soaked in a strong solution of chloride of calcium, and afterwards dried. Over the tray is a loose cover of wire netting, with meshes of $\frac{3}{4}$ inch diameter. The ferrotype plates, with the sensitised tissue squeegeed on to them, are suspended by hooks to the sides of the box, the lid put on, and in the course of a few hours the tissue will be found dry, stripped from the temporary support, and lying on the wire netting.

As taken from the chloride of calcium box it will be too dry to put in the printing frame. I therefore place it in a roomy cardboard box with a loosely-fitting cover (light-tight, of course), and put the box and its contents in a cool place (if slightly damp, so much the better), for half-an-hour or so. The tissue in this way absorbs a sufficient amount

of moisture from the air to be in proper printing condition, and may, therefore, be at once placed in the printing frame, or put away in the press until required. I prefer to use the paper freshly sensitised, or, under any circumstances, not more than a week old.

When the chloride of calcium gets soft and damp, the tray containing it is taken out of the box and put into a hot oven or over the flame of a Bunsen burner until the water which the chloride of calcium had absorbed is driven off, when the tray and its contents are ready for use again.

In preparing to print from the transparency, place this face upwards on a table, take a piece of sensitised tissue somewhat larger than the pencil-marked dimensions on the safe edges, and carefully mark it on the back, so that when cut it shall fit exactly into the pencilled corners of the safe edge. Cut it squarely by means of a straight-edge and sharp knife. Now place the transparency in the printing frame (I find the screw-down form of press, as used by process-workers, to be the best), and adjust the tissue exactly to the pencil-marks on the safe edge, put on the felt backing, and screw down the back sufficiently to secure even contact between the tissue and the transparency.

The Exposure.—Very little can be said on this head. It is, necessarily, a matter for experiment, depending on the quality of the transparency, but with one such as I have described, an exposure equal

to 3 or 4 tints with Johnson's actinometer will be about right. I use with this actinometer, instead of albumenised paper, which soon gets discolored, strips of white paper of the P.O.P. type. This keeps its color very much better than albumenised paper. In actual work the next part of the process would be the development of the resist, but before describing this it will be better to speak about the copper plate and its preparation.

CHAPTER V.

The Copper Plate. Dust Ground. "Devils" and their Prevention.

The Copper Plate.—I have used both English and French makes, and find little difference in the quality of the metal for this purpose; the price, however, is in favor of the foreign make. The surface should be well polished and quite free from scratches, and it is better to order plates ready bevelled, as the bevelling of a plate after engraving is troublesome, and always attended with some risk of accidental injury to the engraved surface.

However bright the surface of the plate as received from the maker may appear, it is sure to require careful cleaning to free it from greasiness. The simplest way to do this is to lay it face downwards, to commence with, on any flat surface free from grit, or anything which would scratch the copper; the back is then well rubbed for a few

seconds with a cloth which has been dipped first in a fairly strong solution of caustic soda, say fifty grains to one oz. water, or thereabouts, and then into powdered whitening. The edges of the plate, and lastly its face, are treated in the same way. The plate is now well rinsed under the tap, and, if the water flows over it without signs of greasiness showing, it is plunged into a very weak mixture of sulphuric acid and water; about two drams of acid to one pint of water will be strong enough. The plate is again rinsed under the tap, and may now show signs of greasiness again; if it does so, repeat the cleaning operations until all signs of grease have disappeared. When this is the case, dry the plate quickly by wiping it with a soft and perfectly clean cloth, and proceed to lay a dust ground.

The Dust Ground.—I find asphaltum in fine powder to be better than any form of resinous material which I have tried, and I therefore use this exclusively. For laying the ground, a specially constructed box is necessary. The usual form recommended for the purpose is one mounted on trunnions, the box being rotated to agitate the contents sufficiently to fill the interior with a cloud of dust. The plate is introduced into this and left until a fine layer of dust in sufficient quantity to form a suitable ground has been deposited. This was the pattern of box which I first used when I took up Photo-aquatint, but I never could be sure of the regularity of the results which I got with it.

I do not refer to the peculiar pattern-marks which make their appearance if the plate is put into the box unsupported by a surface of larger area than itself, but to an irregularity in the quantity of deposited particles. I have never been able quite to satisfy myself as to the cause of this, but I quickly got rid of the trouble by constructing a box according to my own ideas, in which the dust was raised by means of a revolving brush.

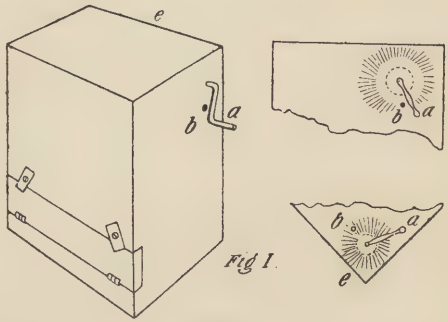

Fig. 2.

I am always sure of the grounds I get in this box, and have used it without modification from the time of my first trial of it. In diagram A, I have given such particulars as will enable anyone to understand the general principles of construction.

a, handle by which the brush is put in motion. *b*, end of metal bar extending from side to side of the box. The bristles of the brush impinge on this bar, and, as they are released, spring up and project

the dust particles of powdered asphaltum into the air. 2-inch wire nails, at intervals of a couple of inches apart, are driven through the bottom of the box. Their points, projecting into the interior, form a support for the plate when inside. A convenient size for the box is 18 inches high, and 12 inches square at the base. This will take a plate up to 10 inches square. About one pint of powdered asphaltum will be enough to put into the box, and will last a long time.

To use the box, it is placed upside down, resting

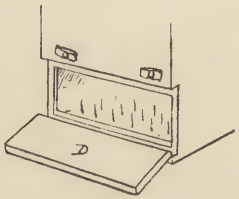

Fig. 3.

on its edge *e* (fig. 2). The powdered asphaltum all falls towards this part of the box, and comes well in contact with the brush. This is quickly turned by means of the handle *a*. About twenty revolutions are sufficient. The box is now stood on its bottom again, the brush again turned for about twenty times, to rid it of adhering powder, and the box smartly struck on sides and top with the palm of the hand to shake down any powder sticking to the sides, and after standing for a suitable time for

the coarser particles to subside (from five seconds to forty or more, according to the character of ground required—the proper time can only be ascertained by experiment), the door, D, is opened, and the plate, resting in the centre of a sheet of glass sufficiently large to nearly cover the bottom of the box, is inserted, the door carefully closed, and the dust allowed to deposit.

Ten to fifteen minutes must be allowed for this.

For a close, fine-grained ground, I always repeat the dusting before fixing the grain.

On removing the plate, it is carefully heated over a Bunsen burner or other suitable source of heat, until the fawn-colored deposit of asphaltum dust changes to a sort of slaty gray. When this point is reached, the plate is put on a cold, iron surface, which quickly abstracts its heat from it, and it is now ready for the next process.

Having laid the dust ground, as described, the usual plan is to proceed to squeegee upon it the carbon negative print, which, when developed, will form the resist, and, when I first was feeling my way in this process, I followed this plan myself. I found, however, that with the relatively deeply-bitten plates which I wished to get, necessitating a prolonged immersion in the etching liquid, I was troubled beyond measure with those plagues of the photo-engraver, known as "devils."

Cause and Prevention of "Devils."

I tried all sorts of experiments to get rid of these "devils," but without success, until it occurred to me that they might be due to minute punctures in the film of the resist, allowing the etching solution at such points to find its way to the copper with greater readiness than would be possible in unpunctured portions, and, consequently, allowing of a much freer and more vigorous action on the metal, which would rapidly, at first, become pitted, and then, from the sides of the pit the etching solution would work its way between the particles of fused asphaltum which happened to be next to the edges of it, producing the curious radiated forms with which photo-engravers are so familiar.

It seemed to me that, if this theory were correct, the simplest way out of the difficulty would be to coat the freshly-grounded plate with a solution of bichromated gelatin, of sufficient strength to form a film which should effectually cover the plate, but not thick enough to interfere in any way with the definition of the picture which the plate was intended to have engraved upon it.

The plate after being coated with the bichromated gelatin, is exposed to light to render the film insoluble previous to the attachment and development of the resist.

I was fortunate in hitting on the proper strength

of the solution almost at once, and delighted to find that the torment of "devils" was at last satisfactorily disposed of, and that instead of having a plate either completely spoilt, or very much disfigured, with perhaps twenty or thirty of these unsightly pits, they were either entirely absent, or, if one or two appeared at all, it was in so slight a form, or in such a position on the plate, that they might be disregarded.

This preliminary coating of the plate with a film of gelatin has a secondary advantage in holding the resist very much more firmly than is the case with the uncoated plate.

The gelatin solution which I use consists of:—

Nelson's No. 1 gelatin, . .	120 grains.
Bichromate of potash, . . .	6 „
Water, ...	9 ozs.

This must be carefully filtered, and applied, whilst warm, to the plate, which must also be warm.

Pour a small pool on the centre of the plate, let it flow first to one corner and then to another, leading it over the surface by the help of a slip of deal, or a glass rod, and as soon as the surface of the plate has been everywhere wetted, pour off the excess of the solution into the containing vessel from one corner of the plate, and put a pencil-mark at that corner.

After draining the plate for half a minute or so, dry it gently over a gas flame, or in front of the

fire, and expose it to sunlight, or the strongest available light, long enough to render the bichromated gelatin insoluble. The plate must then be again coated with the gelatin solution, and this time the surplus solution must be poured off from the corner opposite to the one which has been pencil-marked. The film is then dried and exposed to light as before, and is now ready to receive the resist.

The chief object of the double coating which the plate receives is to ensure a film of even thickness on it.

I have not tried it, but think that, in all probability, in place of using a bichromated gelatin coating, one of plain gelatin, dried, and then rendered insoluble by treatment with formalin, would do as well as that I have described. If it would, there would be a saving of time in using it, as there would be no necessity to expose the film to light to secure insolubility.

[*Note.*—"Devils" may be caused by impurities in the copper plates; and have been attributed in certain cases, by competent workers, to dust of iron-rust which has fallen upon the plate. Mr Huson's treatment, therefore, must be supplemented by care in the choice of the metal and cleanliness in working.—Eds.]

CHAPTER VI.

Mounting and Developing the Resist.

In Chapter IV. I described the sensitising, drying, and printing of the carbon tissue. Its attachment to, and development on, the copper plate have now to be dealt with.

The copper plate, having been prepared as described in the last chapter, is well rinsed both back and front under the tap, to clear it of any chance hairs or dust, and is then placed, face up, in a deep dish containing clean cold water.

The printed tissue is now removed from the printing-frame, and, a mark having been put on the back to indicate the top of the picture, it is dusted on both sides with a clean camel-hair brush, and then immersed, face upward, in the water in the dish containing the plate. The tissue is now quickly brushed with a soft brush to remove any air-bells which might be adhering to it, and is then

quickly turned face downward, and the brush used to remove air-bells from the back.

When first immersed, the tendency of the tissue is to curl with the gelatin side inwards, but, as it absorbs water, it will begin to uncurl, and at a certain point will straighten itself out. When it reaches this point, the tissue must be rapidly adjusted to the position it is to occupy on the plate, and both plate and tissue removed from the water and placed on a flat surface.

The thumb and fore-finger of the left hand are pressed firmly on the left-hand edge of the paper backing, and the squeegee, which must be of the scraper or flat pattern, applied to it from left to right. The position of the plate, as to its ends, is now reversed, and the squeegee again applied, after which it is advisable to go over the plate diagonally several times with the squeegee. The plate should now be set aside for about ten minutes and the developing bath prepared.

Development of the Resist.—For this purpose nothing can be better than a capacious hand-basin, about three-quarters filled with water at 100° to 110° F., a deep dish rather larger than the plate and a pint jug.

These being arranged conveniently with an extra supply of very hot or boiling water at hand, the deep dish is filled with water at 110° F.; into this, plate and tissue are put. In a few seconds the pigmented gelatin begins to ooze out at the edges

of the tissue. When it does so, one corner of the paper backing should be raised with the point of a penknife sufficiently to enable you to grasp it. It may then be readily stripped from the plate and thrown away.

Now take the dish in the left hand, rest it, slightly tilted, on the edge of the basin, in this position, and with the jug proceed to pour the hot water over the plate, keeping up a constant flow by replenishing the jug from the water in the basin. Try the temperature of the water now and then

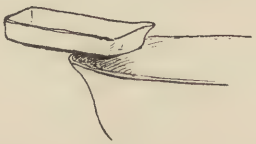

Fig. 4.

and, if it falls below 100 F., bring it up again to 105 or 110 F., by adding hotter water.

When all soluble gelatin has been washed away, and it is important that this should be thoroughly done, the plate should be rinsed for a minute or two in cold water and then allowed to rest in a dish of cold water for about five minutes. Now take it out and stand it on edge to drain for a few minutes, wipe the back slightly, and place the plate in a deep dish containing plenty of *strong* methylated spirit, in which it remains until the resist loses its bright orange-red color, and becomes

somewhat opalescent and dingy. When this is the case, the plate is taken out, drained for a few seconds, and put on a whirler, to hasten evaporation and drying.

Though, as previously stated, the preliminary coating of gelatin which the plate receives causes the resist to adhere much more firmly than is the case where the coating is omitted, it is advisable not to take the developed resist, after drying, into a hot room, as the contractile power of gelatin is very strong, and, under the circumstances, there would be great risk of its detaching itself from the plate completely.

Varnishing Margins.—The resist being quite dry, the margins of the plate must receive a protective coat of varnish. Brunswick black does very well for this purpose.

The first thing to do is to draw a line all round the picture, using a ruling-pen charged with the varnish, guided by a wooden straight-edge. Now give the margins and edges of the plate a good coat of varnish, using a soft brush for the purpose. Allow the varnish to dry, and then protect the back of the plate in the same way. This may be more expeditiously and conveniently done by diluting the varnish slightly with benzoline.

The varnish on the back of the plate being dry, it is just as well to go over the bevelled edges again with varnish.

The plate is now ready for etching.

CHAPTER VII.

The Mordant. Theory and Practice of Etching.

The Mordant.—Perchloride of iron is the basis of the mordant to be used. In the solid form, in which it should be obtained, it is yellow in color and deliquescent.

The most convenient way to prepare its solution is to fill a large wide-mouthed bottle with lumps of perchloride, pour in water in quantity sufficient to just cover the contents of the bottle, and shake at frequent intervals until no more perchloride appears to dissolve.

Pour off the solution, which ought now to be saturated, and allow it to stand for some hours, for the subsidence of heavy insoluble matter. Carefully decant the clear liquid and test its density by means of a Beaumé's hydrometer for heavy liquids. It should register over 40°. If it does not do so, a

further addition of solid perchloride must be made to the solution and shaken up with it until the requisite strength is obtained.

In addition to decanting the solution, by which means heavy insoluble matters are got rid of, it will be as well to filter it through sponge to remove any floating insoluble matters, which are sometimes contained in it.

Supposing the solution to register over 40°, water

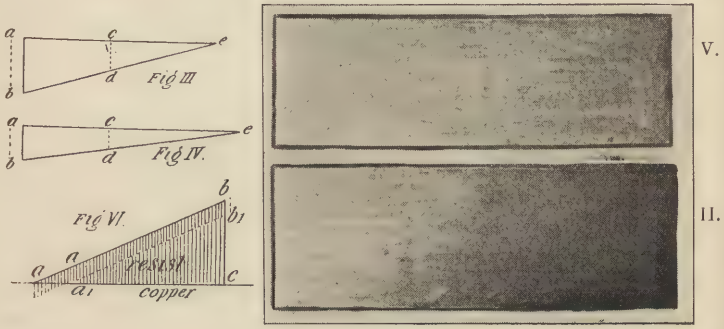

Fig. 5.

must be added to it in small portions at a time, mixing it well after each addition, and trying it with the hydrometer until at 70° Fahr. the reading is exactly 38°. The mordant is now ready for use.

Theory and Practice of Etching.—I should state that previous to the time when I first began to make investigations in photo-aquatint, I was a worker in the old-fashioned processes of Mezzotint

and Aquatint engraving, and was therefore familiar with what the requirements of an engraved plate should be. One requirement is, that the ink-holding capacity of the plate must be such that it should be able to give the full depth of tone of the ink used, at one end of the scale, with every gradation upwards to the light of the unstained paper at the other, as in diagram V.

To produce such a plate, you must of necessity have the engraved or etched portions at the lowest and darkest end of the scale, of a depth just sufficient to hold a quantity of ink to give its full tone, the engraved portions becoming shallower and shallower until they disappear altogether at the upper or light end of the scale.

For the purpose of easy illustration, this is shown in diagram III. in which the depth from *a* to *b* is supposed to be just what would be required for the engraved portions to give the full tone of the ink; *c* to *d*, half-tone; and dying away at *e*, for light.

Assuming that *a*–*b* is the amount of depth necessary for giving the full tone of the printing-ink used, the plate, engraved as in III., would give full range and full gradation, as in diagram II.

On the other hand, suppose a more shallow engraving, as in diagram IV.

In this plate the gradation would be as perfect as the other, but the range of tone would be short, and the resulting print would be like V.

The kind of result which the photo-aquatint

process will give is one in which there is both full range of tone and gradation. To achieve this, transparency, resist, and etching must all be adapted to each other. The two first I have described, and will now take the etching.

There are certain peculiarities connected with this process which should be noted. If we take a saturated solution of perchloride of iron in water, we find that it has no penetrative action on the film of the resist. If to, say, 20 drams of such a saturated solution, we add water, a dram at a time, immersing the resist-covered plate in it, and allowing it to remain in for a minute after each addition, we find that after a few drams of water have been introduced the dilution of the perchloride solution enables it to penetrate the thinner portions of the resist and attack the copper underneath those parts, as is shown by the darkening of the metal. This darkening of the surface of the metal spreads as the etching solution makes its way through the portions of the resist next in thickness to those through which it first penetrated, but, if the addition of water has been only in small quantity, relatively to the amount of saturated solution of perchloride used, the spreading of the discoloration of the metal ceases after a time.

To explain the reason for this stoppage, we will call the water required for the solution of the perchloride of iron, "water of saturation," and that subsequently added, "water of penetration."

In fig. 5 (VI.) we have a copper plate with resist, *b*–*c*, representing the thickest part of the resist, gradually diminishing in thickness to *a*. Now let us see what takes place when this copper plate and resist are placed in the etching solution to which water, in quantity just sufficient to allow of penetration through the thinnest parts of the resist, has been added. Owing to the dark color of the etching solution, and the necessity for watching the progress of its action on the plate, it is usual to employ only so much as will just cover the plate conveniently; consequently, we have a relatively large surface of gelatin to be acted on by a relatively small quantity of water of penetration. This water of penetration at once begins to work through all parts of the surface of the resist, and through the thinner portions it does so sufficiently for the etching solution to make its way and attack the copper. But by the time it has worked into the resist to the depth represented, say, by *a*–*a*1, *b*–*b*1, the whole of the additional water, the water of penetration, has been absorbed, and the etching solution has returned to its saturated condition. Consequently, the thicker portions of the resist remain impenetrable by it until, if the action is to be continued, a further addition of water is made; and so on until every part of the resist has been penetrated and the plate attacked in all places.

A little reflection will show that, given a transparency and a resist corresponding in reverse to it,

which in their gradations and strength of light and dark represent what the print, the final result, is intended to be, what is required in the etching solution is, that it should be of such strength as to be able to penetrate all parts of the film, from the thinnest to the thickest, with steady gradation, in such time as to allow the portions most deeply etched just to acquire the capacity for holding the full amount of printing-ink by the time the etching liquid is about to attack the copper under the thickest portions of the resist, such portions of the plate, of course, being the high-lights in the finished picture. That is to say, instead of following the usual method of employing half-a-dozen or more baths of different densities of solution to etch a plate, one bath only should do the work from beginning to end, without stoppage. I think it will be evident, from what I have stated, that, to work with one solution, your transparency *must* be right: but that if it is right, the final result is a certainty.

Just what your transparency looks like, so will your final result be. A thin transparency will give you a plate which will produce thin, flat proofs. A heavy transparency, proofs of corresponding heaviness. A bright transparency, bright proofs. I find that with the class of transparency which I try for, a solution of perchloride of iron of 38° Beaumé is exactly right. It is as well to note that great care must be taken to see that the solution is exactly 38°; 37½° would be too weak, and would give a plate

weak in the darks; 38½, too strong, and would give a heavy plate.

I use the solution at a temperature of 74° to 76° Fahr., in the proportion of about one dram to every square inch of surface to be engraved. That is, for a 5×4 plate twenty drams; 7×5, thirty-five drams, and so on.

The time of immersion varies, of course, with the range of tone of the subject, but is never less than twenty minutes, and averages about thirty-five to forty. The dish containing the plate must be rocked during the whole time of etching.

Toward the conclusion of the process, when only a few of the highest lights are unacted on, I get the plate in the strongest available light, and the instant that I think the last point of light is being touched by the perchloride, drop the plate, without stopping to wash it, into a dish containing a fairly strong solution of caustic soda, say 100 grains to five ounces of water, which stops all action at once, and makes easy the removal of the resist and preliminary film coating.

The plate is now well washed under the tap, scrubbed with a nail brush, and plunged into a bath of sulphuric acid, two drams in twenty ounces of water, well rinsed again, and the asphaltum ground removed by heating the plate and washing with turpentine. It is then wiped with a clean cloth and again cleaned with soda and sulphuric acid solutions, and is now ready for proving.

It is only after the various cleaning operations just described have been gone through, that the quality of the plate can be in any way judged. When the resist is first removed, its appearance, stained and patchy looking, is most disappointing, and to one unaccustomed to the process would be pretty sure to suggest failure.

Note on the use of the Etching Solution.—It is often stated that the etching solution improves with use, but my own experience is quite opposed to this. The vigorous biting which the plate receives, consequent on the length of time it is exposed to the action of the etching solution, speedily exhausts the latter, and though, using the etching solution in the quantity given above, it *might* possibly retain sufficient energy to etch a second plate, it is poor economy to attempt to use it again. Perchloride of iron is cheap enough, and it is better to use fresh solution for every plate and know exactly what you are doing, than to risk spoiling a plate by working in the dark with a partly spent solution, at the extent of whose remaining etching power you cannot even guess.

CHAPTER VIII.

Outline of the Talbot-Klic Photogravure Process.

Before proceeding to a description of the plate-printing process and after-processes which may be necessary for the improvement of the plate, all of which are common to both photo-aquatint and photogravure, an outline of this latter process is necessary, showing in what particulars it differs from the first-named one. The first point to be noted is the character of transparency best suited to the production of a plate by photogravure. The transparency should be full of detail and gradation, but should have none of the robustness which would be necessary to it if required for photo-aquatint. In fact, if it has detail and gradation, the thinner it is the better. The carbon process is admirably suited to the production of just the class of trans-

parency required, but, needless to say, intensification would be harmful.

The Autotype Company's "special transparency" tissue is the best to use, and all details as to sensitising and drying are the same as those given in Chap. IV. for the preparation of the tissue for the resist. For details of mounting and developing, I refer the reader to Chap. VI., substituting a glass plate coated with a film of insoluble gelatin for the dusted copper plate dealt with in that chapter.

In printing from a transparency so thin as that just described, great care must be taken not to overexpose the tissue. The suitable number of actinometer tints can only be ascertained by experiment. Under any circumstances, endeavor to regulate the exposure so as to produce a resist in which the parts of the film representing the strongest darks in the picture shall be as thin as possible.

The modes of cleaning, ground-laying, and preliminary gelatin coating of the copper, are in all respects similar to those already described under these various headings, as is also the varnishing of the plate.

The preparation of the mordant up to the point of getting a saturated solution, is also the same. But, from this point there is a divergence in the working of the two processes. In photogravure, in place of using one etching bath, from three to six are used of different densities of solution, these

being respectively—45°, 43°, 40°, 38°, 35°, and 33° Beaumé.

In the use of these, the plate is put into the strongest first, and watched to see whether the mordant has any penetrative action on the thinnest portions of the resist. If, after an interval of five minutes, there is no sign of darkening of the copper, the plate is transferred to the bath next in strength. Here perhaps, the mordant may be able to penetrate the film, and the discoloration of the copper must be watched until it ceases to spread. The time during which this action has gone on must be noted. The plate must then be transferred to bath number 3, and so on, until the highest lights of the picture are about to be attacked, when the etching must be at once stopped, as in the photo-aquatint process.

The cleaning operations to which the plate is next subjected are in all respects similar to those described at the end of Chapter VII and the plate is now ready for proving.

CHAPTER IX.

Comparison of Photogravure with Photo-aquatint.

It will be seen on comparing this outline of photogravure with the description of photo-aquatint, that the chief difference in the practice of the two processes lies, firstly, in the different quality of transparency which each requires, and, secondly, in the way in which the etching of the plates is managed.

With reference to the use of one or many etching solutions, the whole gist of the matter lies in this: At some point or other of the process of photo-aquatint or photogravure, you have to surmount the difficulty of getting into the plate correct gradation combined with full range of tone, and it seems to me easier and better to do this at the transparency stage, where you have the picture before you in black and white, and can *see* that it is right before going any further, than to use a transparency,

perfect in gradation, doubtless, but imperfect in range of tone, and then attempt to correct this by the management of the etching solutions at a further stage of the process. The drawback to this mode is the difficulty of regulating exactly the action of each of the etching solutions. A little more or a little less biting in one or other of the baths, and the full range of tone combined with correct gradation which you are trying for is upset. Whereas, by photo-aquatint, if the transparency, resist, and etching are adapted to each other, the result is a certainty.

CHAPTER X.

Printing from the Plate.

A COPPER PLATE rolling press will be required.

Whatever size of press is to be used, I strongly advise the pattern which is worked by means of geared wheels as being much better and pleasanter to work with than that in which the rollers are revolved by means of a cross handle only.

With the press are required thick woollen cloths, known as "blanketing." These should be of larger area than the paper which is to be printed on, and two thicknesses will be required. One piece of "fronting," a stout, closely-woven cloth of even surface to come between the blanketing and the paper, will also be wanted. It is well to have several sets of cloths of both kinds, so as to replace with dry ones those which have become wet in the press.

A Plate Heater.—This is made of cast iron, with machine-planed top, and an arrangement underneath for heating by means of gas.

A Jigger.—This is simply a strong wooden box, with one end out, in which are kept the printer's wiping cloths. Its top is of hard wood, mahogany

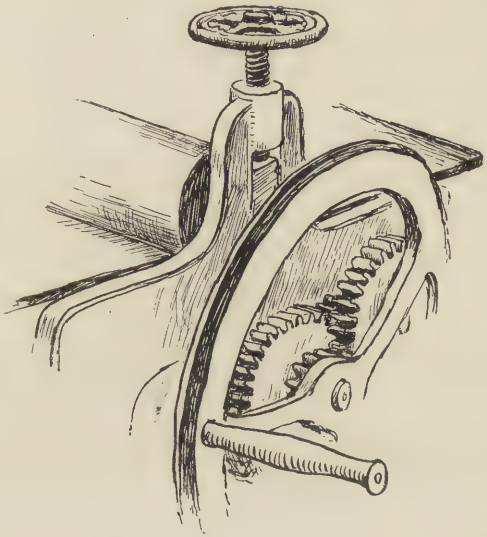

Fig. 6.

usually, and is of a size convenient for the plate to rest on whilst it is being wiped. The jigger and the plate-heater should stand side by side when in use, so that the plate can be readily transferred from one to the other as required.

The Inking Dabber.—This is a tightly-wound roll of flannel, forming a cylinder about 5 inches long, and 2 to 3 inches in diameter. The end which is to be used for inking should be trimmed to a tolerably even surface with a sharp knife. A new dabber will absorb a good deal of ink, and had better be worked into the ink on the inking-slab for some time, to get it in good condition. It should

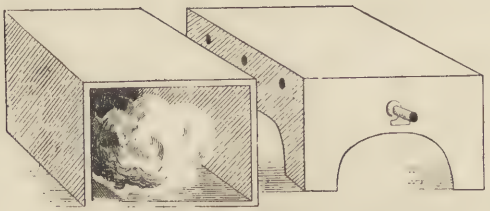

Fig. 7.—Jigger and Plate-heater.

be kept free from dust in a box by itself, and before being put away after use, should be wiped with a cloth, but not otherwise cleaned. With proper care, after a time a smooth elastic coat of hardened ink forms at the end of the dabber, which will then be in nice condition, and may easily be kept so with a little care.

For wiping the plate, two kinds of muslin will be required; coarse for the first wiping, and fine for finishing.

Copper-Plate Ink.—To have the ink in the very best condition, you should grind it yourself just before it is to be used. For this purpose a muller

and an old lithographic stone are necessary, and a supply of the finest Frankfort black, burnt sienna, and crimson, all in powder. These are to be mixed in such proportions as are requisite for the tone of the ink wanted, together with a sufficient amount of middle reducing oil. Ink can be purchased of very fine quality, ready ground. I have had it for many years from C. Roberson & Company, 99 Long Acre, who supply it in collapsible tubes, a convenient form in which it keeps well. With the three pigments mentioned above, mixed in various proportions, every variety of black and brown tint required can be obtained. Burnt umber should never be used ; it degrades the tone and transparency of the ink.

Paper.—Stout plate-paper, either white or toned, and with a grained surface, or good water-color paper, are the best to use. The plate-paper is the easier of the two to manage.

Printing.—Whilst the processes of photo-engraving have had a fair share of attention and description devoted to them during the past year or two, the printing of the plates has been somewhat overlooked, being usually dismissed in a few words of allusion rather than description.

The simplicity of the process may, or may not, have had something to do with this, and yet, in spite of its simplicity—may be in consequence of it —there are but few printers, even amongst professionals, who do full justice to a photo-engraved

plate. The old saying, "If you want a thing well done you must do it yourself," applies with peculiar force to this matter of the printing of photo-engraved plates, and, although it would be manifestly impossible for the engraver, in most cases, to do all his own printing, he should, at any rate, print the pattern proofs, those which are to be handed to the professional printer, as specimens which it is his business to copy as closely as possible, and which, if the full intention of the engraver is to be shown, must be printed by the author of the plate.

The actual operation of printing is, briefly, as follows:—

The plate is made hot on the plate-heater. It must then be inked all over the face with the dabber. Next, the excess of ink is wiped off with coarse soft muslin and the wiping finished with fine soft muslin, and, lastly, the copper margin is cleared with first a piece of dry rag, and second a rag moistened with turpentine. The plate is again made hot and is now placed in position on the bed of the press, a piece of damp paper adjusted over it, the press cloths arranged, and all passed once under the roller. This is the whole operation in brief.

Preparation of the Paper.—Plate-paper should be damped by passing a wet sponge over the back of each sheet; it may then be used at once, but it is better to put it between two sheets of stout plate glass and leave it to stand for half-an-hour or so. Water-color paper should be sponged rather more

freely, and must be allowed to stand (between glass plates) until nicely softened. In some cases when the paper is unusually hard, it may be dipped, or even soaked, in warm water with advantage; this removes some of the size, and leaves the paper in better condition for printing purposes.

Condition of the Ink.—For a weak plate, the ink should be used full strength as received in the tube (if you use it in that form), but if the plate has been strongly bitten (as photo-aquatints are), the ink may be weakened with advantage by mixing with it a small quantity of reducing oil, using middle reducing oil for the purpose. A glazed white china tile, an old lithographic stone, or a piece of thick plate glass, are convenient for mixing the ink on.

The mixing should be very thoroughly done by means of a palette knife. Do not prepare more ink than you think will suffice for the number of proofs you intend to pull, as it soon thickens and skins over, and is useless after a day's exposure. The crimson ink is very strong, and should only be used in sufficient quantity to correct any tendency to an olive-greenish tone which is produced by the mixture of black and burnt sienna.

Inking the Plate.—Place the plate on the plate-heater, and leave it until it is rather hotter than can be comfortably borne by the hand. Whilst still on the heater, take the dabber with some printing-ink on it, and ink the plate all over the

surface. The best way of applying the dabber is with a rocking motion. It must never be rubbed or dabbed on the plate. *This is important.*

Wiping the Plate.—Remove the plate to the jigger, clear off as much ink as you can with two or three strokes of a pad of coarse canvas. Leave the smeary plate to cool. In the meantime, take a piece of fine soft muslin about three-quarters of a yard square, gather it up in the palm of the hand into a soft pad or cushion, and, as soon as the plate feels only just warm, wipe it all over, not, as usually recommended, with circular strokes, which would eventually remove too much ink, but with strokes from side to side, or end to end, of the plate. Continue the wiping of the plate with quick strokes and gentle pressure, using towards the end of the process fresh surfaces of the muslin, and, if the ink is stiff, occasionally warming the pad by passing it over the face of the plate-heater, until any bright spots on the copper, representing high-lights, begin to look rosy when the plate is held at such an angle as to reflect the light towards you.

(Coarse canvas, which has been washed soft, or old lace curtains, or, indeed, any material which is soft and has an open mesh, will do well for the first wiping.

The fine muslin, for finishing, is that known as butter-cloth.)

This is the whole process of wiping the plate.

The bare palm of the hand, which plays so im-

portant a part in the cleaning of plates etched in line, must not be resorted to in the case of such plates as we are now dealing with : the result always shows itself in grainy or even rotten surfaces in the prints.

Carefully clean the margin and edges of the plate, first, with a piece of dry rag, and then with one moistened with turpentine.

The plate, which will now be quite cold, must be put on the heater.

Now see that the press is ready, with two thicknesses of blanketing and one of facing-cloth, the blanketing being next the roller. See that the screws are adjusted to give the requisite pressure to the paper and plate.

Condition of the Paper at the time of Printing.— Plate-paper, as already stated, simply requires to be carefully damped throughout its substance, and is then ready for printing on. Drawing and other hard papers, which have been heavily sponged and wetted, whilst being soft and damp throughout must not have any excess of water in or on them. It is best, therefore, to absorb superfluous water from each sheet, by means of clean blotting-paper, just before adjusting it on the engraved plate.

Adjusting the Paper and Plate, and Printing.— The most convenient way of adjusting the position of the plate to the paper in the press, is to have a thin sheet of zinc, cut somewhat larger, say a quarter of an inch all round, than the paper you are about

to use; place this sheet zinc on the bed of the press, quickly adjust, by the eye, the hot plate, face up, in the centre of the zinc, place a sheet of damp paper, face down, on the plate, and run it through the press once, slowly and steadily; make no pause in the movement. Now remove the paper and examine your proof.

A general darkness and heaviness of the print may be due to insufficient wiping of the plate, or the use of too strong an ink. The remedies are obvious.

If, in spite of the application of these remedies, the plate continues to give prints too dark and heavy, it shows that either the transparency has been too heavy, or the plate too deeply bitten. In the first case, another transparency and fresh plate must be made. In the second, it will be found that the mordant is above 38° Beaumé, and must be reduced in strength before etching a fresh plate. (See remarks in Chapter VII. on the necessity for having transparency, resist, and etching adapted to each other.)

Dulness in the lights may be due to insufficient wiping, or to the process of etching not having been stopped at the right time. If the etching is in fault, the lights must be recovered by the careful use of the burnisher.

A general paleness of the print indicates that either the plate has been over-wiped, that the ink has been too thin and weak, or that the plate has

been insufficiently bitten. In the case of over-wiping, or too thin ink, the remedies, again, are obvious.

With an insufficiently bitten plate, you have to consider whether the degree of insufficiency is large or small. If the former, the shortest and best plan is to do another plate, but first satisfy yourself as to whether it is the transparency or the mordant that is in fault; one or other is certainly too weak, and must be corrected. If the degree of insufficiency is small, the darks can be strengthened, either by the roulette or, far better, by means of engravers' methods of aquatinting, as described later on. It is hardly necessary to say that both the roulette and aquatint require artistic skill and technical knowledge to accompany their use.

If the plate is a properly bitten one, bear in mind that the whole art of successful printing lies in the wiping of the plate. To do it well, simple as it seems, requires a delicate sense of touch, artistic feeling, and practice.

CHAPTER XI.

Retouching and Auxiliary Processes.

As a rule, if the plate requires any afterwork, it will be either in the direction of burnishing the lights to recover any freshness which they may have lost by slight action of the mordant, or the darks may require enriching.

With reference to this last, it is important to note that any work subsequently added to the plate should be of a character to harmonise with that already on it. It is for this reason, amongst others, that I have a strong preference for aquatint as a means of strengthening darks, to any kind of tool-work, such, for instance, as that in which the roulette is used.

The character of the result from any engraved plate is strongly influenced by the method of engraving; and, without going more deeply into the

subject, it will be sufficient to point out that from the difference which exists between the form of the minute pits etched by the mordant, and that of the depressions made by the roulette, as will be seen by comparing the sections of typical forms of the two given herewith, a distinctly different effect is given by them in printing.

The character of the aquatint process being synonymous with that of photo-aquatint and photogravure, it is the best possible one to use where the darks require strengthening.

With these two processes, burnishing and aquatinting, the one for the lights, the other for the

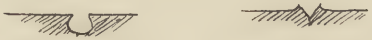

Fig. 8.—Etched pit. Roulette pit and burr.

shadows, all needful corrections on the plate can be made. Before entering on a description of them, I should mention that, in original work, the etched line may be used with great effect, but on no account should its addition be attempted by anyone who has not had a painter-etcher's training, otherwise failure is pretty sure to be the result of the experiment.

Burnishing.—There are various forms of burnishers, but the one which I find serves all purposes well is that figured below. It is known as Whistler's, and can be obtained from Mr W. W. Rhind, 69 Gloucester Road, N.W. To use it, moisten the part of the plate to which it is to be applied with a little

vaseline, and then rub down the copper by passing the polished surface of the tool backwards and forwards over it, keeping a firm and even pressure on it, until you think that the process has been carried far enough, when a proof should be pulled from the plate, which will show you whether more work is required or not.

In *Aquatinting*, the plate must be first very carefully cleaned by brushing it well with a nail-brush and solution of caustic soda mixed with whitening, then well rinsed under the tap, the nail-brush being used at the same time, then dipped for an instant in weak

Fig. 9.

sulphuric acid (two drams in twenty ounces water), well washed again and dried with a soft cloth.

The plate is now to be re-grounded with asphaltum dust ground, using the dusting box exactly as in the first grounding of the plate, but depositing a coarser ground, by allowing, say, five seconds for the coarsest particles to subside, and ten minutes for the dust to deposit on the plate after its introduction.

The plate is now taken out of the box and heated to fuse and fix the dust ground. The next process is to carefully paint all those parts which require re-biting with a water-color mixture consisting of :—

Vandyke brown (tube water-color), 1 part by bulk.
Finest whitening (in powder), . . 1 „ „
Loaf sugar, ... 1 „ „

This is to be mixed with water to the consistence of thick cream. A sable-hair brush is the best to use in applying it. As soon as it is dry, cover every part of the face of the plate, whether painted on or not, with a varnish made by diluting ordinary mastic varnish (such as artists use) with half its bulk of turpentine, mixing up with it just enough of the finest lamp black in powder to darken it, so that you can easily distinguish where the varnish is on the copper plate. Leave the varnish to dry on the plate for one hour. It is best to put the plate in a warm place, in a current of air if possible. At the expiration of the hour, place the plate in a dish of clean cold water, and leave it, covered with water, for another hour. Now gently rub the surface of the plate (still keeping it under water) with the tips of the fingers in all those places where the water-color composition has been applied. You will find that on all these parts the varnish will readily come away with water-color, leaving the dust-grounded copper exposed. Now dry the plate with a soft cloth, and varnish the back and edges with Brunswick black. The plate is now ready for re-biting.

Before proceeding to this operation, you will find it a convenient plan to have a bitten aquatint scale for reference. It can easily be made by dusting a plate, biting it with a series of stoppings out, marking the time of each biting opposite to the part bitten.

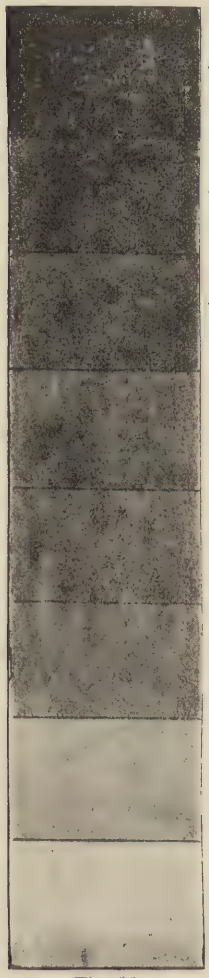

Fig. 10.

On printing a proof from the plate, it will have the appearance of the figure annexed.

Reference to this scale will give you a very good notion of the length of time to etch the plate to get any particular depth of tone which you wish it to have. Any number of tones can be got by successive bitings and stoppings out.

Etched Lines.—If these are to be added to the plate, it may be done either before the aquatinting just described, or after, as preferred. If after, the dust ground must be removed by heating the plate and washing it with turpentine. The plate must now be grounded for the etching process.

After many experiments, I found that a paste-ground applied with the roller and followed by the same ground brushed on to the most deeply-bitten parts of the plate, was the only way of perfectly protecting the bitten photo-engraved ground.

A good composition for a paste-ground is:—

White wax, ...	400 grains.
Gum mastic, ...	200 „
Asphaltum, ...	200 „

Melt these together, and pour them in the melted state into

Oil of lavender, ...	1½ oz.

Whilst still hot and fluid pour the mixture into wide-necked, glass-stoppered bottles, and after it sets, pour a little oil of lavender on the top of it to keep it from drying. With this precaution you may keep your paste indefinitely.

The roller referred to above is specially made for painter-etchers' purposes, and is described as follows by Hamerton in *Etching and Etchers*:—

"It is a cylinder of wood 8½ inches long by 4 inches, with two projecting handles in its axis, each of them about an inch thick and 4½ inches long. The roller is covered with thick, smooth leather, but between the leather and the wood there is a covering of thick flannel to give elasticity. The leather is joined so neatly that the place where it is cemented is hardly perceptible. It is drawn over

the edges of the cylinder, and tightened with strings like purse-strings, so that the edges are rounded and covered. They may be obtained from dealers in etchers' materials. The roller is delivered in a box, which is so constructed that no part of the leather ever touches anything. The box is very important to protect the instrument from dust, and the roller is never taken out of its box for longer than just the time necessary for its use.

To use the roller: Take three pieces of thick plate-glass, lay your plate, well cleaned, on one of these glasses, and have the others on the table conveniently near. Now take your bottle of etching-paste, see that there is no dust on your glasses, and with a perfectly clean palette-knife take some of the paste and spread it equally on one of the glasses in a horizontal band about two inches broad. If the paste is too thick for this to be done easily, add a few drops of oil of lavender, and mix thoroughly well with the palette-knife. Now take your roller and roll over and over again until you spread a film of paste quite evenly on your glass. If the roller is rather over-charged with paste (you will easily judge of this after a few experiments), pass it once on the other glass to get rid of what is superfluous, then apply it to your copper. You ought to be able to lay a thin and perfectly even coat of paste by this means upon your copper. You ought to hear a regular crisp sound as the roller passes over the glass. After some practice the ear will

tell you when it is right. Having done this thoroughly, put the plate on the plate-heater to drive off the oil of lavender, and, whilst still hot, take some of the paste-ground on a brush, and carefully paint over all such parts as appear to have a mat surface. These will be the deepest bitten portions, and such always require an extra amount of ground to protect them from the action of the mordant. As soon as you think you have got on enough ground for the purpose, put the plate aside to cool, and when cool, it may be lined with the etching point.

The details of the treatment of the plate from this point are such as are usual in painter-etching, and the reader is referred to any of the numerous excellent treatises which have been published on that art for further information.

CHAPTER XII.

Steel-facing the Plate.

If only a few proofs, say up to forty or fifty, are required to be pulled from the plate, it may be considered ready for the press after passing through the various processes which have been described; but fifty will be the outside number of first-class proofs which you can depend upon getting from the unprotected surface of the plate, which will soon show signs of wear under the stress of printing.

By the process known as "steel-facing," which is really the deposition of a thin but extremely hard film of iron, by electrolytic action, on the soft copper surface, a plate may be so protected as to bear printing from to almost any extent, as, should the protective film itself show signs of wear, which from its hardness it is slow to do, it can be readily removed without injury to the copper and

replaced by a fresh film of iron. The process is not a difficult one, but the management of the large bulks of iron solution which are necessary, and which are very unstable, is a troublesome piece of business. The worker on a small scale will find it better and more economical to get the work done for him by one of the many firms who make this business a speciality, than to do it himself.

The Apparatus required consists of a strongly-made

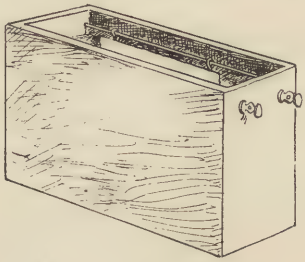

Fig. 11.

wooden trough, which must be either pitch-lined, or strongly varnished inside with several coats of sealing-wax varnish, so as to make it quite impenetrable by the solution which it is to contain. The outside of the box must also be everywhere thickly varnished.

The internal dimensions of a trough intended to take plates up to 10 inches square, should be 2 feet deep, 9 inches wide, and 2 feet long. At the top of the trough, extending from end to end, should be two

stout brass rods. These should be 4 inches apart. One end of each rod must have a binding-screw fixed to it, as a means of connection with the source of electricity.

An anode, consisting of a plate of iron, 20 × 20 inches, and $\frac{1}{4}$ inch thick, is suspended from one of the rods by brass hooks soldered to the back of the plate, the soldering being thickly varnished with Brunswick black.

The plate to be steel-faced is hung from the second rod, by means of hooks temporarily attached to the back by solder, the face of the plate being opposite to that of the iron anode.

Iron-facing Solutions.—I have tried various solutions and give two of the best.

Water, ...	40 ozs.
Chloride of ammonium, . . .	2 „
Double sulphate of iron and ammonia,	1 „
Protosulphate of iron, . . .	1 „

The above salts are to be dissolved in the water, and the solution filtered just before use.

This gives very good results, and does not oxidise quite so rapidly as some of the other solutions which I have tried.

Another extremely good solution which has the great advantage of being free from this trouble of oxidation, as it is made with a persalt of iron, is known as Böttger's. To make it, dissolve one part of ferrocyanide of potassium and two parts of

Rochelle salt in twenty parts of water. Mix one and a half parts of persulphate of iron with twenty-five parts of water, and add it to the former. Now add, drop by drop, a saturated solution of caustic soda to the mixed liquids, stirring vigorously after each addition of the soda, until the liquid changes to a perfectly clear light-yellow color. It is then ready for immediate use.

The greatest care is necessary not to add more soda solution than will just suffice for the purpose; any excess will render the solution quite useless. When properly prepared, it is the pleasantest solution to work with of any I have tried, and gives very good results, though it soon becomes exhausted.

As a source of electricity, either three Bunsen or six Leclanché cells may be used; but I prefer a small dynamo to any form of battery. I have one fixed on the bearers of a lathe, and worked by connecting the pulley by a band to the overhead motion of the lathe.

The illustration shows the whole arrangement in working order. With it I can get a good deposit of iron on a 9 × 6 plate in about twenty-five minutes.

The actual operation of steel-facing a plate is as follows:—The plate must be very thoroughly freed from printing-ink by means of turpentine, followed by benzine. A couple of hooks are then to be soldered on to the back, and the plate is to be well scrubbed

with whitening and soda solution, well rinsed, dipped into sulphuric acid, two drams, water, one pint, and the soda and acid treatment repeated until the plate is absolutely clean. After the final dip in acid, the plate must be well rinsed in water, taking care not to touch the surface with the fingers, and then put into a dish of clean water until such time

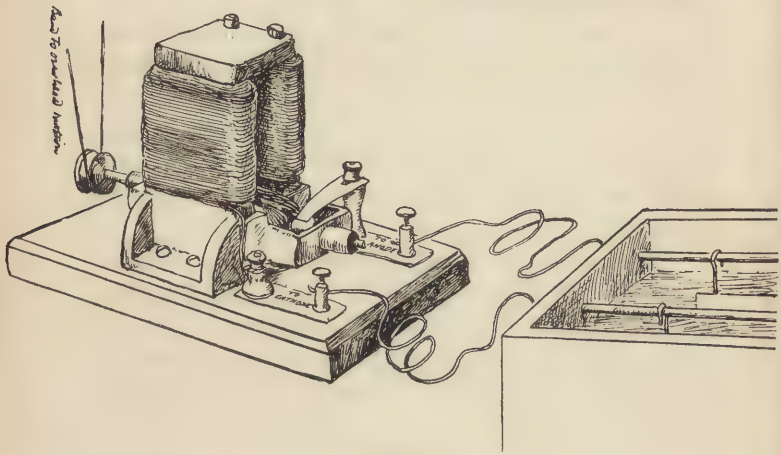

Fig. 12.

as the trough and its contents are ready to receive it.

The trough must now be filled with steel-facing solution, the anode and plate put in position, and the trough connected with the battery, or dynamo, as the case may be, the positive pole being connected with the rod bearing the anode; the negative, with

the plate to be steel-faced, which forms the cathode. A deposit is not secured at once. It is necessary to immerse the engraved plate for a few minutes, take out, and brush well with fine whitening and water. Immerse again, scrub at the end of five minutes, and in four or five immersions a sufficient deposit will be secured. The steel-faced plate must be most carefully washed in hot water after its final removal from the trough. Then wash in cold water, brushing it at the same time dry with a soft cloth, rub with benzine, and oil it, and, if not at once required for printing, make it hot on the plate-heater, and rub over it a piece of beeswax, allowing it to cool with the film of wax as a protective coating on its surface.

CHAPTER XIII.

Making a Reversing Mirror.

In the early part of this work I expressed my preference for a class of transparency which involves working from a reversed negative. As this in many cases necessitates the use of a reversing mirror as the most convenient means to the end in view, it may be as well to describe the making of one.

The following details were first published in an article from my pen in *The Process Photogram*, December 1896.

An important part of the apparatus of the photo-engraver is the reversing mirror. If constructed of optically-worked glass, it is, for the larger sizes especially, necessarily expensive. It is quite possible, however, with a little care in the choice of glass, to construct a mirror of plate glass, which, for all practial purposes, is equal to a mirror of the more

expensive material, and can be made at about one-twentieth of the cost. The difficulties of silvering and polishing are really very slight. The points necessary to be observed to ensure success are purity in the materials, and scrupulous cleanliness in the operations.

I have made many mirrors, and give herewith full details of my mode of procedure.

The glass I use is German plate, which can be had about one-eighth of an inch thick. English plate glass is not now, I believe, made so thin as this, and if the mirror is made of glass thicker than one-eighth it becomes inconveniently heavy. Select a piece which is free from surface flaws or lines, which are occasionally visible in portions cut from the edge of the original plate.

The first thing to do is to remove the sharp edges so as to be able to handle the glass comfortably. This is most readily done by means of a revolving grindstone, but as a stone of this description does not usually form part of the equipment of the photo-engraver, a piece of No. 1 emery paper will do very well instead. Care must be taken not to rub the surface of the glass with emery. The sharp edges being removed, give the glass a thorough rinsing under the tap. When every particle of emery has been washed away, place the wet glass on a clean piece of folded blotting-paper, and rub it over on both sides and edges with a strong solution of caustic soda, applied with a tuft of cotton-wool.

Rinse well under the tap, and again rub all parts of the glass, this time with a few drops of strong nitric acid, using a clean piece of cotton-wool for the purpose. Rinse again very thoroughly under the tap, and finish the rinsing with *distilled* water.

Have a granitine developing-dish ready (the deep pattern, it should be an inch longer each way than the glass to be silvered), with sufficient distilled water in it to entirely cover the glass. Into this put the cleaned glass, and put a cover over the dish to keep out dust. Have a second dish, deep pattern also, and somewhat larger than the other. Cut three pieces of cork, each half-an-inch thick, arrange them triangularly in the bottom of the second dish as a support for the first dish in a subsequent part of the operations. Two pieces of glass rod about the thickness of an ordinary cedar pencil, and sufficiently long to go from side to side of the smaller dish, will be required: each of these should have one end bent at a right angle, about one inch from the end; this will prevent them from rolling about in the dish when put in position to support the glass to be silvered. They must, of course, be cleaned with soda and acid, and rinsed before use.

To make the silvering solution, proceed as follows (I give the quantities for a good deposit of silver on a 9 × 6 mirror):—

Take 100 grains of nitrate of silver, dissolve it in 2 ounces of *cold distilled* water. Dissolve 2 ounces of Rochelle salts in 4 ounces of *cold distilled* water,

add this to the solution of nitrate of silver; a curdy white precipitate is at once thrown down. Now add, drop by drop, stirring vigorously the whole time, strong liquor ammonia; this will gradually dissolve the precipitate, and probably, towards the close of the operation, that is, when the precipitate is *nearly* all dissolved, the liquid will become rather smoky and brownish in colour. Be very careful not to add an excess of ammonia, in fact it is better to leave a small quantity of the precipitate undissolved.

Now add 6 ounces more distilled water and pass the whole through a filter.

The Swedish filter paper is the best and most convenient to use, as it is very pure and allows the liquid to pass through very quickly.

Whilst this operation is going on (it will only take a few minutes), arrange the two dishes, the smaller inside the larger, supported on the three pieces of cork, and in the inner dish the glass to be silvered, supported at its two ends by the glass rods, the distilled water being still in the dish.

The silvering solution being ready, take the smaller dish with both hands, one at each end, and, pressing the mirror-glass firmly against the rods with the thumb of each hand, quickly pour away the distilled water; careful draining is not necessary. Now replace the dish on the three corks, and carefully pour in the filtered silvering solution, hold the plate in position again with the thumbs, as before, and rock the dish quickly several times to mix the

few remaining drops of distilled water with the silvering liquid. See that there are no bubbles left on the *under* surface of the glass, as it is *this* surface which is to receive the silver for the mirror. If there is enough silvering solution to cover the glass all over, both surfaces will receive a deposit; but the one facing the bottom of the dish is invariably the more perfect of the two.

The glass being in position as above, fill the outer dish with boiling water. The effect of the heat on the silvering liquid is at once apparent, it rapidly darkens and becomes opaque and muddy-looking from the deposit of metallic silver.

Do not move either of the dishes, but syphon off the hot water from the outer one, and continue to replace it with fresh portions of boiling water, so as to gradually raise the temperature of the silvering solution to about 100° or 120° Fahr. It will probably take from ten to fifteen minutes to do this, and by that time most, if not all, of the silver will have been deposited. Take out the mirror, being careful not to touch the face, that is, the under side, as explained above, and give it a good rinse with warm water; now wash well under the tap for five minutes, letting the water run over back, front, and sides of the mirror, so as to get rid of all soluble salts, and, finally, rinse with distilled water. This completes the silvering operation, and the mirror should be put in a rack to drain and dry. In a warm current of air, this will soon take place.

If the operation has been successful, you will find a beautiful deposit of silver, perfectly even, without marks or stains of any kind, but with a slight bloom. To remove this and complete the mirror, all that is necessary is to rub it evenly, from end to end, and side to side, with a pad of chamois leather (with a soft stuffing of cotton-wool) on which has been rubbed a small quantity of the finest rouge, such as is used by jewellers and silversmiths. It is safer, when preparing the pad, to give it a good rubbing on a plain glass in the first instance, so as to break down any hard particles of rouge which might scratch and spoil the mirror. The pad should be kept by itself in a box with a closely-fitting lid, and used only for the one purpose. In conclusion, let me emphasise the points which will ensure success; they are, purity in the materials, and scrupulous cleanliness in all the operations.

BOOK II.

MACHINE-PRINTED PHOTOGRAVURE.

CHAPTER I.

Outline of the Process.

For very many years the desirability of an intaglio printing method which would combine the advantages of the photogravure process with the cheapness of letter-press printing has been fully recognised. Photogravure or photo-aquatint, though perhaps the most perfect of photo-mechanical processes for the obtaining of artistic results, necessitates such careful hand work in the printing, that the cost of proofs is necessarily high, and the production of a large edition is unavoidably slow.

In the eighties, the firm of Marinoni, in Paris, built a special machine for photogravure printing,

"THE BISHOP'S PALACE, SALISBURY." MACHINE-PRINTED PHOTOGRAVURE FROM A NEGATIVE BY CATHARINE WEED WARD.

in which the wiping of the plate was done by means of a metal wiper, or "doctor," instead of by hand, and it is said that some very careful French printers succeeded in making this machine compete with hand-printing. Others, on the other hand, including one of the most able of the English printing houses, found that with the delicate and shallow plates used in photogravure the wear of the plate was so great as to far more than balance the saving obtainable by speed in printing.

Meanwhile, in the sanitary wall-paper printing trade, in the printing of fabrics, "American cloth," etc., an intaglio method was being used, with copper rollers or cylinders as the printing surface; and anyone who considers the cheapness of sanitary wall-papers, will understand that the printing method must be economical, both in labour and in the wear of the printing surface.

In the printing of transfers for pottery decoration, too, there is a largely-used method in which flat intaglio copper plates are employed. In this the printer floods the plate with color, and wipes it by drawing the blade of a steel knife or scraper across its face.

In both these processes, however, the printing-plates (or rollers) differ essentially from photogravure or photo-aquatint plates in two distinct directions. Both of these depend upon the fact that the design is punched into the face of the plate with steel punches, instead of being cut into it with a graver,

or etched with a mordant. The little diagram shows imaginary sections of the lines obtained by the different methods. *A* is the work of the graver, *B* of the mordant, *C* of the punch. Thus, while the engraved or etched line becomes thinner and thinner as the plate wears, the punched line or dot remains exactly the same until worn down to its base. Hence, the wearing of the plate greatly affects the engraved or etched design, while the punched one is but little affected.

Further, and this is still more important, in the ordinary photogravure we have practically solid

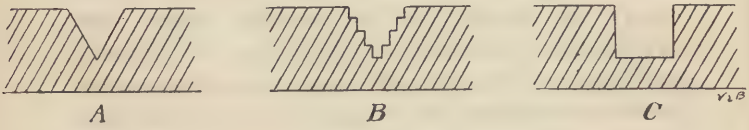

Fig. 13.

washes of color, in which graduation is obtained by the varying depth of the biting, which causes varying amounts of ink to be laid on the paper, so as to wholly cover the color of the paper in the shadows, while in the half-tones the paper shines through the ink. In the punched design all the holes are (or may be) of the same depth, and the gradation of tone depends upon their size in relation to the white spaces between them. Here, again, it will be seen that the punched plate has the advantage on wearing; for, as the face of the photo-aquatint

plate is worn, the high-lights extend into the paler half-tones until the print comes to consist of broad, hard, exaggerated high lights and faint, weak shadows with but little gradation between.

An incidental, but very important, advantage of the punching method is that it greatly hardens the rollers or plates.

The knowledge of these processes must have led many photogravure workers to sigh for some means of combining the advantages of their photographic process with those of the slower and in many ways inferior punching method.

At length the perfecting of the half-tone process, and particularly of the method in which copper is employed, with a fish-glue resist, suggested the way to obtain a good deal of what was desired. For some years a process which combines the photogravure, the half-tone, and a mechanical printing process has been in successful operation, producing prints up to about 40 in. × 30 in. of such perfection that they have had large sales in the print-sellers' shops, and yet at a cost of production with which hand-printing cannot attempt to compete.

More recently other firms have gone into the work, obtaining equally beautiful results by methods which are probably a modification; and some outline particulars of the working have been given at the meetings of the Royal Photographic Society.

Of course the exact details of these firms' procedure are guarded as secret processes, and the

following chapters do not pretend to give a working description of any of them. They do, however, give information wherewith any man with a knowledge of photogravure plate making and of the half-tone process can very quickly make himself proficient as a maker and printer of machine-printed photogravure plates or rollers.

CHAPTER II.

Transferring a Film Resist to Metal Plates or Rollers.

[Method of A. Villain, Officer of the Academy.]

The reader is supposed to have a knowledge of the use of the half-tone screen; of the preparation, printing, and developing of a fish-glue resist; and of the etching of a copper plate. If he requires further information on these points, he is referred to the volumes of *The Process Photogram*, 1894, '95, '96, '97, in which the progress of half-tone photo-engraving has been chronicled month by month. Or he may refer to the other books in the present series.

The following instructions are extracted from an article by A. D. Villain, of Paris, which won the prize offered by *The Process Photogram* in 1896 for the best article on a photo-mechanical subject, and which was published in the issues of that journal for July and August 1896. Monsieur Villain says:—

"Pursuing our researches on the employment of photography for printing fabrics, we have made several trials of the 'Enamel Process' and of a method called 'the modified glue process,' having obtained at last on rollers a photographic film, suitable for etching. In the course of these experiments we have made several interesting notes, which we have incorporated in the account of the process we have the honor to present to you. We have found also:—

(1.) That gum, albumen, ordinary gelatin, and all other colloid substances can withstand being baked to form an enamel, and to give a perfect film (a peculiarity that has, perhaps, been remarked and indicated by others before ourselves).

(2.) That the coating of the roller with the sensitised solution can be done away with, and that the trouble of reversing the originals can be avoided.

(3.) That by our process a film suitable for engraving can be easily carried over on to a copper roller or other metallic surface.

To briefly outline the process:—A sheet of paper, coated with gelatin, gum, albumen, etc., is sensitised on a bath of ammonium bichromate. After drying in a place sheltered from white light, it is exposed behind a cross-lined or grained negative (not reversed). The image is developed with cold or tepid water, then the sheet of paper is brought into contact, image downwards, with the roller or metal plate. The excess of water and bubbles of air

interposed between the two having been driven out, the whole is dried and then heated over a gas stove or in some other manner; the paper burns away, leaving the image in contact with the metal, and all that remains to be done is to etch the plate in the usual way.

In the recognised processes up to the present time, the sensitised solution is spread on the plate to be engraved, dried, and exposed behind a reversed negative.

Gelatined Papers.—Sheets of paper coated with two to five per cent. solutions of gelatin are employed. They may be purchased, under the name of transfer papers, or we can prepare them ourselves, taking care to employ thin paper, but of good quality, free from any product that might render the gelatin partially or even completely insoluble, and very soluble gelatin. One of the sheets is taken and dipped in the following sensitising bath:—

Distilled water, . . .	60 c.c.
Egg albumen, . . .	40 c.c.
Ammonium bichromate, . .	3 grms.

If the solution is turbid a few drops of ammonia are added to it. When the gelatin is thoroughly impregnated with this solution, the excess of liquid is drained off and the sheet is hung up to dry, either in the air alone or on talced glass, but guarded thoroughly from all white light. The sensitising of these tissues should be conducted in the same manner as for the carbon process, taking care above all

things to pass a brush over the tissue on the gelatined side and over the back during sensitising to avoid the microscopic bubbles that always form on the surface of these tissues when they are placed in water. Only one sheet of tissue should be sensitised at a time, and this should be done only a short time before it is required, for they only keep good for three or four days in summer and seven or eight in winter. Avoid a higher temperature than 35° C. in drying the sensitised tissue, and do not heat the room where the drying is being conducted by gas or by a stove. These are the causes of the partial or total insolubility of the gelatin. The bad smells produced, resembling escaped gas and drains, are also a nuisance. By sensitising in the evening the paper required for the next day, and by drying it during the night in a well-ventilated apartment, shielded from all white light, we shall obtain the best results. When once they have been dried, the papers must be preserved from light and moisture.

Exposure.—The sensitised tissue is placed in the printing-frame behind a line or half-tone negative, or positive. A negative is employed when an engraving in relief is desired, and a positive when the reverse effect is required. The exposure is very short. It varies according to the intensity of the light, the intensity of the negative, etc., etc., and should be gauged by a photometer. An exposure of fifteen minutes to diffused light at this period of the year (15th October) is sufficient. For

development the print is placed in cold water, renewed from time to time until all the chromium salt not acted upon by light is removed. The development is continued with tepid and even with boiling water, if it is necessary to dissolve completely all the gelatin that has not been rendered insoluble by light. To examine the development better, and to keep an easier watch over the state of the print, after the first few washings with tepid water the others can be made with water containing a little eosine or other aniline coloring matter, which, by adhering to the places where the gelatin has become insoluble, stains it in whatever color is used, and allows us to see better what results are being obtained. Only the gelatin that has been acted upon by light must be allowed to remain on or in the substance of the paper. The development can be made in ordinary daylight, but care must be taken to place the print to soak in water on removing it from the printing-frame before taking it from the dark room.

When the development is finished and all the detail has been brought out perfectly, the print, thoroughly moistened, is transferred face downwards, *i.e.*, with the image in contact with the metal, on to a plate of copper, brass, zinc, etc., taking care not to leave any air bubbles between the tissue and the metal. The metallic surface ought to be thoroughly clean, free from grease and roughly polished to obtain perfect adherence. The least trace of grease

(the application of the fingers for example) prevents the gelatin adhering to the metal. The contact ought to be made under water, *i.e.*, by placing the metal plate under the tissue whilst still lying in the dish, and lifting them both out of the water together. If not pressed the plate is left to dry quietly ; but in the opposite case the drying can be hastened by moistening the back of the print slightly with alcohol, and heating it with a lamp or in some other manner.

Baking the Enamel.—The plate of metal, having the tissue in contact with it, is placed on the hot plate just as in the half-tone enamel process. The heat is raised by degrees and very slowly at first until a temperature of 340°–400° C. is attained. The addition of albumen to the sensitised bath permits us to carry the temperature up to 400° C., but the plate can be withdrawn on arriving at about 340° if the paper is destroyed. The heat must be continued until the complete destruction of the paper is brought about, especially when plates of copper are being used. To judge the temperature, little pieces of lead can be placed on the edges of the plate that is being baked; their fusion (335° C.) will indicate that the plate can be removed, or that the heat can be reduced. Other metals or alloys can be employed according to the temperature that we wish to obtain. In consequence of the heating of the plate and the high temperature, the paper is consumed, burnt, and reduced to an ash, and there

no longer remains on the plate to be engraved anything but the photographic transfer, which has the closest possible contact. In the course of our experiments we have noted that it was preferable to leave the paper to dry after its transference to the metal and before baking; it then carbonises more easily.

The desired temperature having been obtained, the plate is left to cool very slowly, and, by the aid of a piece of dry or moistened rag, the particles of paper which still remain attached to the metal are removed. To hasten and to ensure the complete destruction of the paper, when it has been heated to about 150° C., we can take the plate by the aid of the tongs, and, turning it upside down, move it backwards and forwards over the flame of a Bunsen burner or a gas stove, bringing the paper in contact with the flame. If, on passing a plug of cotton-wool or a brush over the surface, several places are observed where paper still adheres, it is sufficient to bring those parts over the flame, and to heat afresh.

This modification allows of burning the paper more promptly, and of obtaining transfers on to zinc plates more easily; for if the zinc plate is left on the hot plate, the metal may be fused before the paper is destroyed, especially when thick paper is being used, and when it has not been dried sufficiently before proceeding to bake the enamel. When it is observed that the image is perfect and complete to its smallest details, it is washed under

the tap, dried, and any retouching that may be necessary is proceeded with, and it is then ready for biting.

Biting the Plate.—The biting is secured by the usual means, but much more easily, because the film is so much more substantial. For copper plates it is preferable to use a solution of perchloride of iron of 45° Bé., which may be heated up to about 30° C. After remaining in this solution for 15 to 20 minutes the plate is engraved to a certain depth. If a deeper biting is required, it is necessary to roll up, an operation well known and described in handbooks, which allows us to obtain as great a depth as we wish.

Albumenised Papers.—Very good, and above all, very delicate, results are obtained by using single albumenised papers, or papers with a very weak coating of gum, modified glue or "liquid glue," etc., etc. The mode of procedure is the same; the sensitising and development alone being different. In sensitising these papers they cannot be left to soak in a bath (as the medium being soluble in cold water would be dissolved), so this is how the operation is performed: the papers are floated, film side up, on a bath composed of—

Water, ...	100 parts
Ammonium bichromate, .	3 to 4 „

care being taken to avoid air bubbles that may form between the sheet of paper and the surface of the

liquid; a few minutes suffice for this operation; the liquid, owing to a capillary action, traverses the sheet of paper and comes into contact with the film of albumen, gum, etc., etc. The operation is stopped when the coating has acquired a shiny appearance. The sheets of paper are dried by suspending them by the aid of clips or pins; they cannot be dried on talced glass. The exposure to light is perhaps a little longer, a few trials determining the course to be pursued in subsequent operations. Development is done in the cold: the print is placed in water tinted by one of the aniline colors, is left there until the image has appeared completely, and is then washed in cold water, a soft camel's-hair brush or a squeegee being passed lightly over the surface. The transfer should be carried out immediately. If the print has been dried it must be moistened afresh before making the contact, taking care to pass the squeegee very lightly over the surface to avoid air bubbles. The transfer made, the roller squeegee is passed over it, or the plate and its accompanying film are placed under a press of some kind. The pressure may be much greater than for transfers with a gelatin base. It is either left to dry in the air, or is heated by a stove or on the hot plate, moderate treatment being used. The plate, when dry, is baked in the manner already described. It is unnecessary, we believe, to remark that the surface of the paper can be coated with the solution of albumen, gum, etc., containing the needful quantity

of bichromate of potassium. In coating these films it is sufficient to take the usual precautions. We believe, however, that it is simpler to keep a stock of sheets of paper coated with albumen, modified glue, etc., and to sensitise them when required.

Papers with Caoutchouc under Gelatin or Albumen, etc., etc.—The high temperature required for the destruction of the paper might be a hindrance to the employment of this process on plates of zinc or any very fusible metal or other material; so we have searched for a means of rendering our process applicable for transfers on all surfaces. To arrive at this result, in place of employing ordinary paper as a support for the gelatin, albumen, etc., nitrated paper or pyroxyl can be used; it is only necessary then to heat very lightly to destroy the support and leave the film. The employment of nitro-cellulose presenting some possible dangers, the notion of using paper with coatings of caoutchouc and of gelatin has occurred to us. Our first attempts have been made with the paper films of M. Balagny, with three superposed coatings: (1) a layer of caoutchouc; (2) a coating of collodion; (3) a layer of gelatin. The results have been very satisfactory, and we have asked the firm of Laney to make us papers with thin layers of caoutchouc and gelatin, with an intermediate layer of collodion.

The sensitising of these papers is the same as for papers coated with gelatin alone. The drying, exposure to light, and development are made also

in the same manner. The image, when developed, is placed to dry. At the time of transferring it is moistened with cold water, always squeegeeing the surface. The contact is made under water. The transfer effected, the whole is left to dry tranquilly ; then, when drying is complete, a plug of flannel or cotton-wool soaked in benzine or petroleum spirit is passed over the back of the print and rubbed in sufficiently to render the layer of caoutchouc soluble. First, one of the corners, and then the whole of the paper is lifted off, the image remaining adherent to the metal. The plug soaked in benzine or petroleum spirit is passed very lightly over the surface to eliminate finally all traces of caoutchouc, and then the enamel is baked to any extent that may be desired. This modification allows us to make transfers even on to lithographic stone, or on to wood, or any other surface with much greater ease than by any other process whatever. The bichromated gelatin, after exposure to light, resists the action of weak acids, even without having been heated or baked, but it can be endued with a much greater power of resisting the action of acids by passing it through a 1 per cent. solution of formalin.

Transfer to Rollers.—Contact can be given by means of a flat rubber squeegee, which is pressed on the roller directly after the application of the image, or by means of a roller squeegee, or in any other manner. By employing papers containing a layer of caoutchouc, the paper can be lifted off very

readily, leaving only the photographic transfers. To bake the enamel, the rollers, when the transference is finished, can be placed in a stove heated to 250° to 300° C. Also, to bake the enamel and to carbonise the paper we can operate thus: the axle of the roller is rested on two bearings (as when turning it in the ordinary way) and turned, either directly over a gas flame, or in the interior of a fixed tube or pipe of cast or wrought iron, heated by a gas burner, or in some other manner. This would take the place of the stove and the hot plate.

Before placing the roller in direct contact with the flame a thorough drying of the transfer is to be recommended, and, if possible, the roller should be placed for a few minutes in an air-bath, heated to about 100° C. For biting the plate the iron pipe and gas burner are replaced by a boat or trough containing perchloride of iron or the acid solution chosen. To obtain great depth or strong relief the processes recognised and employed in other methods, such as rolling up, etc., etc., can be utilised. All that we have said in regard to transfers on to flat surfaces can be repeated here.

Retouching.—The retouching of the transfers so obtained is very easy: by the aid of a scraper the parts that we wish bitten by the acid can be raised up; the parts to be preserved from the etching being covered with varnish by the aid of a pen or pencil dipped in the following solution:—

Water, ...	100 parts.
Strong modified glue or liquid glue, .	5 „
Bichromate of potash, . . .	2 „

The gaps are filled up, the lines are gone over again and corrected as required, etc., etc., and the retouching is left to dry, and the plate, roller, or block is heated afresh to secure for this retouching the same strength as possessed by the rest of the film."

It is only necessary to add to Monsieur Villain's careful instructions the suggestion, that for the modern process of machine-printed photogravure, it is necessary to lay upon the metal surface, before transferring the resist, a dust grain as described by Mr Huson. This breaks up and somewhat modifies the edges of the half-tone dots. In this process, the half-tone image secures gradation of light and shade independently of the gradation of depth of the etching, thus giving to the photographic plate one of the advantages of the plate prepared with punches. The etching, too, owing to the possibility of rolling up and re-etching, is much deeper than is possible with the photogravure method.

The plate, as in ordinary photogravure, may be steel-faced for the increasing of its durability, and even after it is appreciably worn can be rolled-up with a fatty ink and etched still deeper without such a loss of quality as is unavoidable from the wearing of the photogravure plate.

CHAPTER III.

More Durable Plates and Rollers

[Suggestions by J. William Smith.]

The great advantages offered by the photo-mechanical processes, as compared with the punching method of preparing rollers for the printing of sanitary wall-papers, have induced the wall-paper printers to experiment in this direction. The softness of the finished roller, as compared with a punched roller, and the other considerations mentioned in the last chapter, have caused these workers to largely abandon the photographic process; for a method which is cheap enough for making prints for book illustration may not be cheap enough for wall-paper printing. Still, the experiments are not abandoned, and some valuable suggestions may be gathered from a paper contributed to *The Process Photogram*, June 1897, by J. William Smith, an engraver of rollers for wall-paper printing. This

paper, curiously enough, was the prize-winner in 1897 in the competition corresponding to that which was won by A. Villain in 1896.

Only the small portion which directly bears upon the present question is quoted. Mr Smith says:—

"The manufacturer would willingly discard copper for a cheaper metal substitute, since he is always obliged to have on stock a large number of engraved copper rollers, just in the same manner that a photographer is obliged to keep a vast stock of negatives. I know of one firm alone, which always has in stock something like two thousand rollers. This means a great capital laid out and bringing in no interest, as it were. Finding the same difficulty, the fabric printers have adopted, with great success, cast-iron rollers or shells coated with copper one-sixteenth of an inch thick, the copper being deposited by electrical means, on which they engrave.

"The fabric printers are able to take advantage of this class of roller, because they engrave by an etched-out process. But this class of roller will not withstand the punching method used for engraving for wall-papers: the chief reason why copper rollers are used for engraving for wall-papers is, that copper being a somewhat soft metal, it is easily punched, therefore specially adapted to the present method of engraving.

"Copper is employed, also, because no chemical action takes place between the color and that metal. If iron or steel rollers were used, a chemical action

would be set up between the color and the iron or steel, contaminating the colors and spoiling their purity. Such rollers would also be liable to rust and spoil when not in use. Nickel, on the contrary, is a very suitable metal for the requirements of wall-paper printing, but it is very expensive, and to engrave it by the present method would be out of the question, on account of its being so very hard and brittle. To render a photo-process engraved roller capable of withstanding the necessary wear and tear, I propose to use an iron roller, on which a coating of nickel has been deposited by electrical means. The coating of nickel will suffice if it be about one-sixteenth of an inch thick. The next operation will be to take off a thin skin of the nickel surface, in the turning lathe, to make the engraving surface true and level.

"The roller will now require to be polished on the polishing lathe, by means of coarse sandstone, followed with yellow-stone, medium, and lastly with fine water-of-Ayr stone, exactly in the same manner that we should polish an ordinary copper roller. The roller is now ready for engraving by means of an acid, for a roller of this description will not withstand punching.

"Seeing that the photo-mechanical method of engraving is an etched-out process, I think we shall have secured a means by which wall-papers can be printed, which, for artistic results, will be superior to anything that has yet been accomplished. At

the same time we shall have an engraved roller that will outlast at least three copper rollers engraved by present methods. Further, I believe such rollers could be produced cheaper than the present copper rollers, seeing that while the copper rollers are produced by rolling, the iron cores we should require would be produced by casting.

"With reference to the proposed new method of photo-engraving being cheaper than the engraving method now in vogue, I cannot say, since I do not know what will be the cost of the photographic method. But seeing that the present engraving is produced by hand work alone, it stands to reason that such a method is slow and tedious. Therefore, I think I may venture to say the proposed new method will be much more expeditious, and that goes for a great deal, as it enables a manufacturer to get a design quickly on the market. To give any idea of the cost of present method of engraving is rather difficult, as so much depends on the size of, and the quantity of detail in the design to be reproduced. Probably, on an average, the price per roller ranges from £3 to as high as £20, and I shall be strictly under the mark when I say that no less than £15,000 per annum is paid in wages for this class of engraving in England alone. And when I say that engraving for wall-papers was practically unknown twelve years ago, you will see that this industry is rapidly extending."

CHAPTER IV.

The Method of Printing

(as employed in the Sanitary Wall-paper trade).

[From a paper contributed to *The Process Photogram* by J. William Smith.]

Taking it for granted we have a sanitary wall-paper printing machine of the single color type, before we can start printing, we shall require to wrap, very tightly and evenly, a kind of cloth, known as lapping (a cloth composed of linen and woollen), around the iron cylinder marked *A*. Wind round in one continuous length of lapping, sufficient to form a thickness of one inch. The width of the lapping will be governed by the width of the design you require to print. Supposing the design measures twenty inches in width, you will require your lapping cloth to be twenty-four inches wide, thus allowing two inches on either side. This wrapping is in order that the paper to be printed may be well pressed down into the engraving on the printing roller. We shall now require an endless woollen

printer's blanket, which can be obtained all in one piece and without seam. To put it on the printing machine, it will be necessary to raise one end of the cylinder (*A*) out of the machine's side, which is arranged for that purpose. The woollen blanket will require to be two inches wider on either side than the lapping. Having got the woollen blanket on the machine, the iron mandrel (*B*) is pushed through the engraved roller. Inside this roller is a tab which fits into a corresponding groove in the mandrel, so as to prevent the engraved roller turning round on the mandrel whilst printing. If we require to print from an engraved roller of more than fifteen inches circumference, an iron cone to fit the size of roller required must be pushed into the roller and the mandrel into the cone. Having fixed the engraved roller on the mandrel, it is placed in the machine. The trough or color-box (*D*) containing the color, contains also a wooden roller, and is adjusted underneath the engraved roller, so that the engraved roller comes in contact with the wooden roller. On the end of the wooden roller (*C*) is a cog-wheel which fits into a cog-wheel on the mandrel (*B*), so that both revolve at once, which keeps the color well mixed and serves the engraved roller with color. Having got so far, we shall require to fix the doctor or metal wiper behind the engraved roller, at an angle of 35° or thereabouts (see detail sketch). The doctor will first require to be filed with a steel file

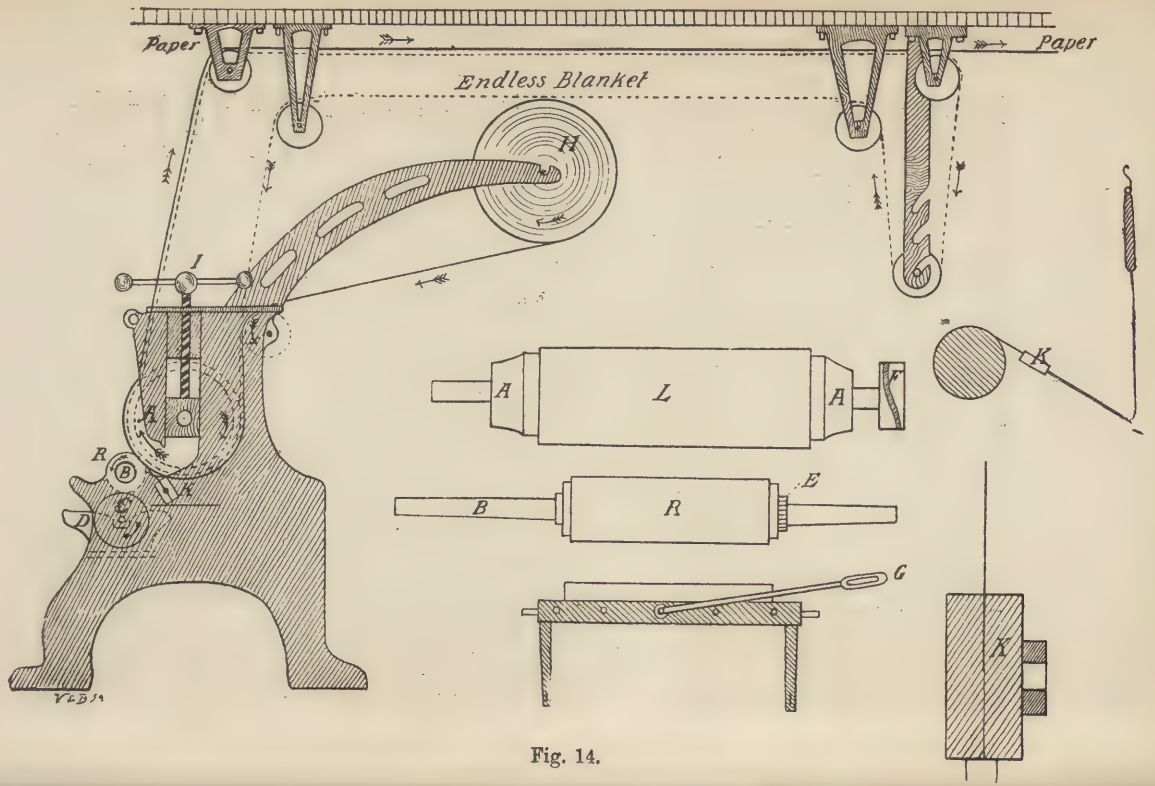

Fig. 14.

in a parallel direction, at an angle of about 70° ; it will now require to be whetted or rubbed in a parallel direction with an oil-stone and oil till we can get a nice, sharp, clean and level edge. Unless this operation of filing and whetting is performed somewhat accurately, the doctor will not wipe the engraved roller perfectly clean. On looking at the sketch you will see at each end of the framework which holds the doctor a short pivot. These pivots fit into steps on each side of the printing machine. To the ends of the arms are fitted chains and spiral springs; these are hooked on a bar fixed across the machine, and adjusted so as to give the requisite amount of pressure of the doctor on the roller. It is then customary to beat a sort of rat-tat with the fingers'-ends on the doctor all the way across, and from the peculiar sound emitted, it is possible to tell whether it is properly adjusted or not. We now adjust the traverse rod (*G*) in position, which gives a short traversing motion to the doctor in order that it may not be worn down more in one place than in another by coming in contact with a deeply engraved portion in one particular place on the roller. We now thread the paper from the paper-roll, marked H as shown on the sketch, and apply sufficient tension to the paper-roll mandrel by means of a spring, not indicated, so that it will just turn round without tearing the paper.

The ink is now poured into the color-box, after it has been well strained or filtered through a very

fine cloth in order to free it from grit and foreign matter. If we omit to do so considerable annoyance will be caused by the doctor and the engraved roller getting scratched. The color must be about the consistency of ordinary house paint. The printing machine is now set in motion, and after seeing that the engraved roller and the roller in the color-box revolve in proper order, the set screws (*I*) are screwed down simultaneously, and as soon as contact is formed between the engraved roller and the iron cylinders (the paper and printing blanket between, of course), the printing blanket and cylinders are set in motion, the paper when printed being carried upwards and over the top of the machine as indicated by the arrows, by means of the blanket. If, when printing, we should discover fine hair lines being printed, other than what there should be, the doctor is at fault if the hair lines are not parallel with the sides of the paper. We shall require to take the doctor out of the machine, and by running the thumb-nail across it we shall find that somewhere near the place indicated by the line there is a notch. The doctor will require to be filed and whetted with oil stone and oil until the notch is removed. If there should be a tint or scum on the paper, the doctor is either not evenly adjusted or not properly whetted.

It will be seen by the above brief description that no particular skill is required in the process of printing. A very little practice soon enables an

ordinary workman to whet and adjust the metal wiper so as to obtain good clean results.

The paper used for wall-paper printing is not of good quality, because the finished article has to be sold as cheaply as possible, otherwise better results could be obtained by adapting the paper to the printing requirements. The paper must be slightly absorbent but not to an extent to cause the color to spread. On the other hand, if the paper be very hard on the surface the color will have a tendency to run.

The description applies only to single color printing. Machines are in use for printing sanitary wall-papers up to as many as twelve colors. The operations to be performed are exactly the same with each roller and doctor.

When two or more colors are to be printed it is, however, necessary to get the separate colors in exact register. The method of doing so is simplicity itself, but difficult to describe in writing. On the end of each engraved roller is engraved a ring, and while unconnected each roller is so adjusted that each color ring drops exactly on the top of the preceding one, thereby obtaining exact register of each color.

It is also necessary that every roller, excepting the first, be slightly larger than the preceding one in circumference, owing to the fact that the paper stretches a little from being slightly damped by receiving the preceding impressions. When in good

working order a machine, working any number of colors, is capable of printing about six yards per second.

After the machine has been printing some little time (especially when two or more colors are being printed) you will notice, as the newly printed paper passes between each engraved roller and cylinder, a certain amount of fluff and color is deposited on the plain surface of the engraved roller, which, if allowed to continue, would seriously contaminate the other colors. To prevent this it is necessary to adjust a metal wiper or doctor on each side of engraved roller, which cleans off all fluff and color, and so prevents contamination.

CHAPTER V.

Additional Suggestions.

Resist Varnish.—A varnish for covering the edges and back of the copper plate, and for protecting the spaces which it is not desired to attack in re-etching, may be made as follows:—

Fuse $\frac{1}{4}$ lb. of asphaltum in an iron pot over the fire, using as low a temperature as will suffice for the purpose. When fused, add slowly, stirring all the time with an iron rod, $2\frac{1}{2}$ oz. of boiled linseed oil. When the asphaltum and oil are thoroughly incorporated, allow the mixture to cool somewhat; then add, with constant stirring as before, $\frac{1}{2}$ pint of oil of turpentine, and, as soon as cold, bottle for use.

This gives a good Brunswick black, but the reader is advised to purchase the varnish ready made: it can be procured almost everywhere of good quality, and is troublesome to make.

Wiping Rag.—(Coarse canvas, which has been washed soft, or old lace curtains, or, indeed, any material which is soft and has an open mesh, will do well for the first wiping.

The fine muslin, for finishing, is that known as butter-cloth.)

Rollers for Experimental Work.—It will be well for experimentalists to realise that a complete roller and spindle need not be used for each printing surface; indeed, as far as expense for metal is concerned, experiments on roller work need not be so expensive as experiments on plate work, provided that advantage is taken of the seamless copper and brass tubes now obtainable, and a roller body is once for all made to suit the size of tube selected. Although both copper and brass seamless tubes are obtainable of even thickness and quite smooth inside, we would suggest the latter as being more likely to suit for the machine work of the future as foreshadowed in our articles of last month; brass being far less likely than copper to tear or groove under the pressure of that metal scraper or doctor which promises to be the ink-wiping device of the future; at any rate for the first wiping. Brass instead of copper, as a material for the intaglio, is no novelty either for plates or rollers, and the special reasons for preferring copper will probably not apply to the photogravure of the future. It may be mentioned that very many of the intaglio engravings in the older books were made, not on copper plates, but on brass plates, and many of the old brass intaglio plates are to be seen in the Plantin Museum at Antwerp. Especially would we recommend that kind of seamless brass tube, which was originally manufactured for

tubing locomotive boilers and is now so largely used for pump barrels and other purposes. This tubing is surprisingly uniform in thickness, true to the circle and smooth inside and outside, and costs retail about 1s. per lb. It can be obtained in London at Smith's Metal Warehouse, St John's Square, Clerkenwell, and a convenient size for experiments or small work is $2\frac{7}{8}$ inches in diameter, and about $\frac{3}{32}$nds of an inch thick; the weight of this being about $2\frac{1}{4}$ lbs. to a foot run. In purchasing this tube one simply asks for seamless tube, which sufficiently distinguishes it from the brazed tube, rough inside, used in ordinary gas fitting, or the brazed mandrel drawn tube. The size mentioned having a circumference of nine inches is quite suitable for prints on crown quarto paper or even a little larger. With respect to the mounting of the metal tube on the holding roller little need be said, as there are several easy ways; one being to use a little soft solder at the ends, and another being to have a small notch in each end of the tube. One of these notches can engage on a block or key permanently set in the roller, and the other notch can be filled by a similar block screwed down with a countersink-head screw. It must be remembered that the lengths of seamless tube are very slightly taper; so the mounting roller will have to be turned to the smallest inside diameter, and in other cases the thickness will have to be made up by thin paper. When the rough tube is mounted on the roller and

this latter is mounted in the lathe the surfacing is very easy. In connection with coating and exposure, such expedients as rotating in the lathe while a trough of the coating liquid is raised upwards, the use of a broad Blanchard brush against the rotating cylinder, the employment of film negatives, and binding spirals of the thin rollable celluloid, are among those which suggest themselves.

—*The Process Photogram.*

Observations on J. William Smith's Suggestions.

By Edward Cross.

The statement that an engraved roller will give about three times more impressions than can be got from a process one is rather surprising, but it leads to the supposition that the copper had not been properly planished, a supposition which is supported by the author's theory (doubtless the true one) that the present mode of hand engraving by means of punches causes compression of the copper, and consequently hardens it in every part of the pattern. Given an etching on well-planished copper, and I will hazard a very emphatic opinion that it will be found to stand wear as well as an engraved one, provided always that the lines and dots are as deep in the one as in the other.

Good photogravure work is not an altogether automatic process, and the difficulties in the way of

working it on a cylinder, from the time of attaching the resist till the finish of the work, would be much greater than when working on a flat plate where, having the design before him at one view, the operator could watch the progress of his work and more readily avail himself of such means as stopping-out and re-biting than he could possibly do when etching on a roller. And this leads to the question, "Why not do the work on a flat surface?" It would not be a great difficulty to curve an engraved plate and attach it as a skin to the iron cylinder, brazing the two edges of the plate together, smoothing the joint at the surface, and securing continuity of the pattern.

I have one other proposal which I consider would be well worth trying. Go to work the other way about, and etch in *relief* on a thin plate of hardened steel, and use this as a die to transfer the pattern on to an already prepared copper roller. The copy, of course, would be an intaglio one. A method much akin to this is in well-established use for making the surface rollers for printing textiles. The trouble in this case would be to produce a sharp clear etching of sufficient depth, with good wall-sided lines; but etchers have had so much experience in this direction that there must be many of them quite equal to the task.

A great advantage of this latter mode would be economy of storage. The original cost of the steel plates (of course not reckoning the value of the

work that may be put upon them) would be but trifling compared to the cost of rollers; they would occupy but little space when put away, and could be readily transferred to rollers when wanted. This practice would, to a very appreciable extent, reduce the amount of sunken capital represented by the large number of engraved rollers a manufacturer at present finds it necessary to keep in stock.

Since the above was written, an article on "Machine-Printed Photogravure" has appeared in *The Process Photogram* for September, which may be regarded as a welcome contribution to what is becoming a useful series on intaglio process work for printing from rollers; to which I should like to add a few words. I have no doubt whatever of the possibility of printing good photogravure work from the roller, and, moreover, believe that in the very near future it will be done, seeing that the times are ripe for it by reason of the facile and fascinating art of photogravure itself, winning its way so rapidly into public favour. It would seem simple enough—hardly more than a new application of an already existing machine—but the crucial difficulty to be overcome will be found to be that alluded to in the concluding paragraph, namely, the ink which it will be necessary to use. The pottery people employ an ink largely charged with oil, which is driven off by evaporation during the operation of firing, and the wall-paper color is comparatively thin and slobbery. Neither of these have

much adhesive affinity for a polished surface of metal, whereas the ink that would be required to produce good prints from a photogravure must have a strong vehicle for its base, capable of carrying a good body of color, must dry quickly, and preserve its intensity. Such an ink will be found to have a much stronger affinity for the metal surface than the others, and will not be so thoroughly removable by the knife-edge of the "doctor," resulting in dirty whites and other troublesome blemishes. To obviate this, an additional wiping apparatus would have to be produced, something in the way of an endless band of a thin and slightly resilient material, which should travel with the revolutions of the roller, and which should also be cleaned in its turn as it goes along.

Preparing Metal for Resist.—In Mons. Villain's article on the preparation of the engraved copper rollers, in which the process of attaching a developed carbon print to a copper roller is described, the fact is not mentioned that it is necessary to use a substratum on the copper roller in order to cause the print to stick. This is a point upon which all who have had any experience of carbon printing are sufficiently informed. For those who are not, we may add that the clean copper roller is coated with a solution of gelatin and chrome alum. The following solution may be taken as a type:—

Water, . . .	12 oz.
Gelatin, . . .	300 grains

Soak and dissolve by heat, then add *slowly*,

Water, . . . ½ oz.,

Chrome alum, . . 15 grains.

Filter and apply a thin coating while the solution is hot. It is possible that a weaker solution may be found to answer. The coating must be as thin as possible, only just enough to hold the print on the metal. When the carbon resist is enamelled there is a danger, if the gelatin is thick, to get an enamel of more or less degree of hardness, according to the thickness all over the metal, which prevents the etching for a time and tends to make it irregular.

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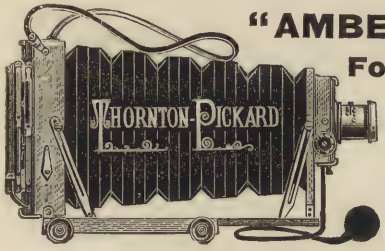

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